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THE INFLUENCE OF TASK DEMANDS UPON THE LEVEL TO WHICH STIMULI ARE PROCESSED

BY

© PETER D. HOLT

A THESIS
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ABSTRACT

The present study was an investigation of a levels of processing approach to the perception of verbal material (Craik & Lockhart, 1972). The goal of the investigation was to determine if words are automatically encoded to the structural, phonemic, and semantic levels, or if task demands terminate processing at more shallow levels.

The method used involved concatenating standard levels of processing orienting tasks (semantic, phonemic, and structural) with a lexical decision task. There were four priming relationships between the levels words and the lexical decision items (associative, rhyming, physically similar and neutral). For example, the levels word for a rhyme decision might be *dog*. Immediately following this a lexical item would appear. An associatively related lexical item would be *cat*, a rhyme relationship lexical item would be *log*, a physically related lexical item would be *dig*, and a neutral lexical item would be *car*. It was assumed that the levels at which the levels items were encoded would determine their efficacy as primes in each of the priming relationships type. Thus, the way orienting tasks influence priming effects, should provide a measure of the degree to which they control stimulus encoding.

The most important finding was a complete suppression of associative priming in the semantic orienting condition compared to a control condition where participants did make any type of

decision about the levels word. This suppression of associative processes in the semantic condition demonstrates that semantic access alone is not sufficient to support associative priming. Thus the lack of associative priming in non-semantic tasks found in the present study and other studies should not be interpreted as strong evidence that processing is terminated prior to the semantic level. Despite the fact that inter-task interactions might be disrupting the processes underlying priming, there was some evidence for processing continuing automatically to the phonemic level in the structural task.

The apparent presence of these inter-task interactions between the levels and the lexical tasks led to the hypothesis that these interactions contributed to the to the suppression of associative priming. The presence of such interactions suggests caution in making inferences about the type of processing that occurs in a single task alone from data collected using a contenated task methodology.

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Introduction

The purpose of this study is to investigate an approach to perceptual processing of the printed word which assumes that incoming verbal information may be encoded at a number of different levels (Craik & Lockhart, 1972). This study will be concerned with the three levels of processing most commonly referred to in the literature: (1) structural, (2) phonemic, (3) semantic. It will focus on the degree to which task orienting demands control the level to which a stimulus is processed. The method to be used involves assessing whether orienting questions affect the ability of a target word to act as a prime for a subsequently presented word. Presumably, the efficacy of the target as a prime is an indicator of the level to which it was processed.

It will be assumed that processing at the structural level produces a representation or code of the physical appearance of a word, phonemic level processing produces a code of the sound of the word, and semantic level processing produces a code of a meaning of the word. In this study, the term code will be used to refer to a relatively impermanent activation of the human perceptual-cognitive system. At some levels of processing, this activation may be purposefully maintained by rehearsal and it may be part of the process leading to much more enduring changes in the perceptual-cognitive system.

One area in which a levels model has been frequently offered as a description of perceptual processing of the printed word is human memory (see Craik & Lockhart, 1972; Craik & Tulving, 1975; Friedman & Bourne, 1976; Jacoby, Bartz & Evans; Jacoby & Craik, 1979; Parkin, 1979). This particular model has generated a tremendous amount of research. However, the model has not been fleshed out in regards to the dynamics of its perceptual processing component (Treisman, 1979). One way to elaborate the model would be to utilize a contemporary human visual information processing framework (see Townsend, 1974). It might be fruitful to integrate a 'levels approach' with this other widely used framework. To this end, a set of bipolar dimensions commonly used to describe visual information processing systems (serial-parallel, exhaustive-self-terminating, independent-dependent, and limited capacity-unlimited capacity; Townsend, 1974) could be used to investigate processing dynamics within and between levels.

Models can differ in numerous ways in their inter-level processing dynamics on these bipolar dimensions. This thesis will focus on one bipolar dimension: self-terminating versus exhaustive processing as it might apply to a general levels framework of perceptual processing.

In an exhaustive system, once processing is initiated it proceeds through all levels. Although not formally identical, the concept of exhaustiveness is closely linked to the concept of automatic (Posner & Snyder, 1975), where automatic refers to a process which occurs without using capacity and without the subject's volition. In this paper exhaustive processing will be considered to proceed without the subject's volition.

A self-terminating system is defined as one in which perceptual processing is terminated upon the production of the desired code. The fact that exhaustive processing may be characterized by automaticity does not mean that self-terminating processes must be under conscious control. The task demands, rather than the subject, might control the termination of processing prior to the activation of other codes. While 'self-termination' may have a connotation of serial processing, there is no intent to restrict theorizing to serial models. If one assumes that the output of structural level processing becomes available before phonemic level output, which in turn precedes semantic output, the predictions in relation to self-terminating versus exhaustive processing are identical for parallel and serial models. Such an assumption has been made explicit by Craik and Lockhart (1972), Posner (1969, 1973), and Leiber (1977) and seems implicit in much other research.

Other models of information processing in the literature have quite a different view of information processing than the one presented so far. Both the cascade model proposed by McClelland (1979) and the interactive model of reading proposed by Rumelhart (1977) assume that different codes do not become available in an all or none fashion for further processing. Instead, information from a particular stage (or level) of processing becomes available for processing at other levels, even as processing continues at that level. Thus, these types of models do not produce a strict temporal ordering of the availability of output from different levels of processing. In fact, the interactive model explicitly assumes that some higher level output precedes lower level output. Nevertheless, both the cascade and the interactive models do seem to include a less strict ordering, in which the lower level processing is generally completed first.

These more recent models can still be dichotomized on the dimension of self-terminating versus exhaustive but the predictions differentiating self-terminating versus exhaustive become quantitative rather than qualitative. For example, within an interactive model, processing which terminates when structural level processing is completed would produce a weaker semantic code than would semantic processing. Although, the standard levels approach has been challenged by more interactive models (Baddely, 1978; Craik & Jacoby, 1979), some support for the more extreme view of processing ordering still exists (Craik, 1979).

The original levels of processing model (Craik & Lockhart, 1972) associated with this stricter temporal ordering also was concerned with the issue of whether task demands determine the level to which a stimulus is processed. It maintains that performance on a memory task is a function of the perceptual analyses carried out on the stimulus at acquisition. A stimulus may be encoded at a shallow or a deep level; the deeper the level of encoding, the greater the probablity of successful recall or recognition. There is a general consensus that the order of levels in increasing magnitude of depth is structural, phonemic, then semantic.

A crucial assumption of this approach is that the experimenter can control the level to which the participant processes the verbal stimuli. This procedure consists of asking the subject various types of questions (Hyde & Jenkins, 1969; Craik and Lockhart, 1972). It is assumed that these questions determine the way in which he/she will encode the stimulus words. A semantic orienting question such as '*Is pearl a jewel?*' ensures '*pearl*' is encoded to a semantic level. Similarly, a phonemic orienting question such as '*Does pearl rhyme with furl?*' ensures that '*pearl*' is encoded to a phonemic level. A structural orienting question typically asks if the word is in upper case or lower case, or if a certain letter is present in the word. Not only is it assumed that the orienting question ensures encoding to the specified level but it is also assumed that the orienting question prevents encoding to any deeper level (Craik, 1979). In a large number of studies, it has been the case that subjects who are given deeper level orienting questions show substantially higher recall and/or recognition than subjects who are given shallow level orienting questions. There is no independent evidence, however, that the difference in recall is due to immediate differences in depth of encoding at presentation produced by the different orienting questions. In fact, studies by Morris, Bransford, and Franks (1977) and McDaniel, Friedman and Bourne (1978) show that the typical levels effect can be reversed depending on the type of test used. Nevertheless, it is a critical assumption of the Craik and Lockhart model (1972) that the perceptual system is self-terminating under the control of the orienting questions.

Triesman (1979) has also noted the lack of empirical evidence for differential perceptual processing. She outlines a number of ways that levels as processing mechanisms might be interrelated, and points out that disentangling the interrelationships may not be an easy task. Yet it is a necessary task, if one is to develop fully a levels model of perceptual processing. The present investigation is seen as a first step in that direction.

The preceding paragraphs briefly describe the original levels of processing model. However, there is some degree of uncertainty as to whether the theorists originally associated with the approach still maintain (1) that depth of processing is a critical variable in determining the durability of the memory trace, and (2) that the experimenter can control the level to which the subject processes information. The current theoretical position of those theorists is not critical to the present study. Nevertheless, their position will influence the direction of the discussion of the results and these results may be relevant to their position. Thus, their current position concerning these two questions should be clarified.

With regard to the first question, Jacoby and Craik (1979) state that differences in memory performance are not determined solely by differences in depth of processing. Instead, they maintain that the concept of *distinctiveness* is also necessary to explain these differences. Distinctiveness is a dimension related to how easily discriminable a trace is within the memory system. Distinctiveness may covary with depth, but it is also dependent upon the degree and type of elaboration within a level. This concept of elaboration comes from Craik and Tulving (1975) where elaboration is defined as "breadth of analysis with each domain". Thus, stimuli can be encoded to the same level but differ in the elaboration of encoding within that level, "a minimal core encoding can be elaborated by a context of further structural, phonemic, and semantic encodings" (Craik & Tulving, 1975). The concept of code in the present paper is similar or identical to the concept of minimal core encoding used by Craik and Tulving and does not necessarily refer to more elaborate encoding within a domain.

Distinctiveness is not solely dependent upon pure elaboration, which refers to quantitative encoding, but is also dependent upon the degree to which the encoding differs from other encodings. It is this latter attribute of the encoded information that makes an encoding distinctive.

It cannot be denied that researchers associated with the levels approach have made the preceding and other modifications to their model. In fact, most of the recent empirical research produced by the investigators from a levels framework has focused on the elaborative processes which are presumed to take place with a level or a domain of processing (Fisher & Craik, 1981). However, many theorists do not entirely wish to drop the concept of depth as a predictor of memory performance. Instead, it now shares explanatory power with these other concepts. For example, Craik and Tulving (1975) still maintain that retention after a minimal semantic analysis will lead to a more enduring trace than extensive structural processing. Also, Jacoby and Craik (1979) retain the notion of depth to describe qualitative differences in encoding processes. Thus, while differences in memory performance are no longer explained *purely* in terms of depth, it appears that the assumption that memory performance is a function of depth, is still a cornerstone to this approach.

With regard to the whether levels theorists still assume that visual processing of words is a self-terminating process that can be controlled by orienting questions, the theorists themselves seem undecided. They definitely do not want to maintain that on each and every trial under all conditions, the only information encoded by the subject is that needed to answer the encoding question. Jacoby and Craik (1979) argue that if after determining whether words are in upper or lower case, subjects recall the words, they must have encoded more than the information that a word was printed in upper (or lower) case print. However, this does not directly address the self-termination issue in relation to between-levels processing. That is, subjects may encode more than information about the case, but they do not necessarily encode beyond a structural level to a phonemic or semantic level. They may very well have encoded a literal or abstract visual (structural) copy of the word.

Craik and Tulving (1975) are a bit more explicit about whether the level to which the system continues processing is always controlled by the orienting question. They maintain that if the subject is given an intentional learning instruction (that is, he knows he must recall the words presented), it is implausible that processing is terminated at a shallow level, even in a shallow orienting task. Yet in a more recent theoretical statement, Lockhart, Craik and Jacoby (1976) appear to retain the role of self-terminating processing in their theory. "We do not believe it is very useful to talk about verbal encoding as 'automatic' (read 'exhaustive') except perhaps in certain contexts." They admit there may be exceptions to the general statement that processing proceeds only as far as the target depth but nevertheless maintain that such cases are just exceptions. Also, Craik (1979) defends the self-terminating view, stating that it is unlikely that a non-semantic orienting task may simply yield a weaker semantic trace instead of a qualitatively different code. In summary, it seems that the concept of self-terminating processing that is controlled by orienting questions is still central to the levels of processing model.

Empirical Evidence on the Issue of Exhaustiveness

There has already been a great deal of research that relates to the issue of self-terminating versus exhaustive processing. Much of this research has been done in the area of memory, with direct reference to a levels of processing model. However, research from other areas also relates to this issue. For present purposes the empirical evidence both for and against self-terminating processing will be broken down into evidence from memory research and evidence from other areas.

Evidence from Memory Studies Contrary to a Self-Terminating Model

Coltheart (1977) and Wright, Ciccone, and Brelford (1977) present evidence which they interpret as contrary to a self-terminating model. In Coltheart's and Wright et al.'s experiments the semantic and phonemic levels manipulations were presented as within-subject variables. After presentation of the items subjects were given a surprise recognition test. In both studies, it was found that that subjects made as many errors to distractors that were semantically similar to the phonemically processed items as they did to the distractors phonemically similar to these items. The false alarm rate was higher for both these types of items than for control distractors. On the basis of their results both Coltheart (1977) and Wright et al. (1977) maintained that subjects could not be terminating processing when the relevant phonemic level was reached. Instead, they also must be processing the stimuli at the semantic level.

This interpretation could be questioned on a number of grounds. First, Davies and Cubbage (1976), using a similar paradigm, present results which are in direct conflict with the above investigators. They report that subjects in a phonemic orienting condition, who were given an incidental recognition test, made more errors to phonemically similar distractors than to semantically related distractors. A plausible explanation is that Davies and Cubbage (1976) used a between-subjects design, whereas, Wright et al. (1977) and Coltheart (1977) presented all three types of orienting questions to each subject. It may be that only a within-subject design induces the subjects to process to all levels and reduces the efficacy of orienting questions. This hypothesis is supported by the results of Coltheart's second experiment, in which a between subjects design was used. For subjects who were presented phonemic orienting questions at acquisition, the pattern of results was more similar to Davies and Cubbage (1976). Phonemic orienting items to which subject responded negatively still produced higher errors to semantic distractors than to neutral distractors. However, items to which subjects made positive phonemic decisions produced as many errors to neutral distractors as they did to semantic distractors. Overall, Coltheart (1977) concluded that non-semantic orienting questions did seem to reduce semantic encoding.

A more general criticism of the interpretation of the results of Coltheart (1977) and Wright et al. (1977) is the difficulty in determining whether the effects they report are the result of encoding processes or processes operating during the recognition phase of the experiments. For example, it is plausible that in these experiments the "to be recognized" items are originally phonemically encoded and are only semantically encoded during the later test trials (perhaps because of semantic priming by the semantic distractors). These types of experimental tests cannot differentiate the validity of this interpretation from one in which subjects are assumed to encode semantically during the presentation of phonemic orienting trials.

Other data have been used to criticize a self-terminating model. Postman, Thompkins, and Gray (1978) argue that, at least on some trials, subjects must encode to a deeper level than the task demands, because recall is not zero following structural orienting questions. This argument is based on the assumption that the only possible representation at a structural level is information concerning the case in which the word is printed. This is not a necessary assumption. Instead, structural level processing might consist of a record of procedures (Kolers, 1975) or a literal visual copy (Kroll and Parks, 1978). In fact, a structural representation similar to latter suggestion would seem to be an appealing basic assumption of the specific structural level processing. Other evidence cited by Postman et al., (1978) is the substantial overlap betweem distributions of item difficulty under different encoding conditions (Postman & Kruesi, 1977; Postman et al., 1978). They argue that since the same items tend to be the most difficult across orienting conditions, the items must be encoded in the same way across orienting conditions. Postman et al.'s (1978) interpretation of this effect is not the only plausible one. First, a large number of word attributes are positively correlated (Whaley, 1977). It may be that an item is encoded differently in the different tasks but may be difficult to process for all tasks because of its values on different but correlated attributes. Second, it is possible in sequential processing that items which are difficult to process at an early stage will provide poorer input to later stages. Therefore, item difficulty will be correlated across levels. Finally, it is plausible that the interitem correlations could arise from processes occurring at recall rather than at encoding.

The latter criticism also applies to a number of other studies which have produced effects purported to be contrary to a self-terminating model. For example, Hyde and Jenkins' (1969, 1973) report of associative clustering following a non-semantic orienting task and Hunt, Elliot, and Spence's (1979) report of an effect of associative meaningfulness on recall following a non-semantic orienting task both used long-term recall as the dependent measure. It cannot be determined whether the obtained effects arise during encoding, the retention period or during recall.

Nelson, Walling and McEvoy (1979) offer another demonstration against the efficacy of orienting questions as a means of preventing encoding to a semantic level. In their second experiment they ran a modification of the usual phonemic orienting procedure. Subjects were presented 48 rhyme pairs with 24 single meaning targets (e.g., *tower-flower*) and 24 dual meaning targets (e.g., *peck-deck*). Then on the unexpected recall test subjects were cued with associates of the target words (e.g., *tulip* as a cue for *flower* and *cards* as a cue for *deck*). It was found that recall was significantly higher for the single meaning targets than for the dual meaning targets. It was asserted that recall was lower for dual meaning targets (such as *deck*) because they were encoded in either of two-ways (as in *boat* or as in *cards*) and the cue (*card*) was effective for only one of these encodings. Nevertheless, the design is weak with regard to any conclusions concerning the way in which the target words are immediately encoded. The effect may be due to the activation of a semantic representation for the words at recall rather than during the encoding. The use of associative cues may intensify any tendency to activate the semantic representations during recall.

In summary, there is converging evidence that processing in the standard levels paradigm is not self-terminating. However, the design of these studies leaves some question as to whether the critical effects are the result of processes occurring at encoding or during retrieval. A demonstration of evidence obtained at the time of encoding would be much stronger support for exhaustive processing.

Evidence from Memory Studies Supporting a Self-Terminating Model

The most cited evidence in the literature supporting self-terminating processing the fact that deeper level orienting questions lead to better recall. However, depth as an explanatory concept is totally confounded with recall, the phenomenon that it is explaining. Nelson (1977) also has noted this circularity. The lack of an independent measure of depth trivializes this evidence. More acceptable evidence is presented by Jacoby, Bartz, and Evans (1978). They found that associative meaningfulness (*m*) interacted with orienting level. The semantic orienting question group showed greater benefit from high *m* nonword lists than did the phonemic orienting group. The authors pointed out that these data support the contention that orienting questions do control the type of encoding. However, in this study the stimuli were nonwords rather than words. A demonstration with word stimuli would provide greater generalizability.

Evidence From Other Sources Contrary to a Self-Terminating Model

An obvious source of data related to this issue is the dichotic listening research. Certain studies in this literature suggest that even when the task requires subjects actively to ignore semantic information from the unshadowed channel, semantic processing still occurs (Corteen & Wood, 1974; Lewis 1971; MacKay, 1973). Even ignoring the fact that that certain of these findings have not or cannot be replicated (see Wardlaw & Kroll, 1978), the degree of generalizabilility from the auditory modality to the visual modality is unclear. Besides the difference in modalities, the task demands also are quite different. In the dichotic listening task, subjects are to process some words and to ignore other words. In the levels memory paradigm, subjects are to process specific features of words and presumably ignore other features of the same words. It may be that self-termination occurs for levels of processing within a single item (as in the levels paradigm) but selective processing does not occur between words (as in the dichotic listening paradigm).

Other evidence apparently contradicting a self-terminating model comes from research into the Stroop effect. In this paradigm the participant is presented words that are printed in various colors of ink. The task is to name the colors of the ink. In the Stroop condition the words are color names which are incongruent with the color of ink in which they are printed. In the control condition the words are not color names. It is invariably found that the subjects in the Stroop condition are slower in naming the ink color than are the subjects in the control condition (see Dyer, 1974, for an extensive review of the literature). In this case, it is very difficult for the subject not to process color words to a deeper level even though it is against the subject's own interest. However, it seems that this is a rather special situation in that participants may very well be primed to process these words to a deeper level. That is, the repeated activation of the representations of color names may set participants to process color words to a 'name' level. This contention is supported in that a Stroop effect does not occur for noncolor words as compared to random letters (Dyer, 1974) and is increased for primed color words (Warren, 1972). It may be that subjects can avoid processing to a deeper level except when the stimulus is primed for deeper processing by task demands. In the exceptional case of priming, it may be impossible to prevent processing occurring at a deeper level. This is not at all incompatible with the levels model as presented by Lockhart, Craik and Jacoby (1976). However, such priming effects would not be expected to occur using the typical orienting question procedure.

The strongest evidence for exhaustive processing comes from three studies which involve matching a target to a comparison stimulus. Leiber (1977, Expt. 3) demonstrated that phonemic similarity between two words (for example *truce loose*) slowed *No* decisions based on physical identity instructions. That is, subjects took longer to respond negatively to rhyming word pairs than to unrelated word pairs. This indicates that despite physical identity instructions subjects process phonemic information. However, the robustness and reliability of this phenomena is somewhat in question in that the effect was not reliable in her first two experiments and did not occur in a study by McCondry, McMahon-Rideout & Levy (1979).

A study by Donnenworth-Nolan, Tanenhaus, and Seidenberg (1981) involved the auditory presentation of a target followed by a list of three words. The subjects task was to indicate which of the three list words rhymed with the target words despite the phonemic nature of the match; it was found that if the first word, in the list was associatively related to the second word matches were faster than if the first and second words were unrelated. Donneworth-Nolan et al. suggest that the first word must have been processed to the semantic level in order to produce this associative facilitation.

This result may be somewhat questionable in that for the related, the first word was of higher frequency than for the unrelated pairs. Nevertheless, an analysis of covariance showed that although the effect was reduced, it remained reliable. Thus with auditory presentations there is converging evidence of exhaustive processing.

Finally, Henderson and Chard (1978) had subjects visually search a long list of words for a target which was physically defined. They found that if the distractor items were semantically related to the target, visual search time increased. Furthermore, the relative size of the effect increased with list length. Again, this is strong evidence for exhaustive processing. However, the nature of the task is such that it may be that natural reading habits are primed to a much larger extent than would be the case in a standard levels paradigm. Furthermore, a replication of this effect in a markedly different paradigm would give greater generality to the claim for exhaustive processing.

Evidence From Other Paradigms Supporting a Self-Terminating Model

Matching tasks have also provided data that appear to support self-termination. In such studies the subject is presented two words and asked to make judgments about the visual (structural) identity, the rhyme (phonemic) identity, or the meaning relatedness of the two words (Leiber, 1977: McCondry *et al.*, 1979). It has been found that acoustic identity slows *No* decisions about semantic identity. That is, if a participant is asked if two words are synonyms, his latency to respond negatively to two nonsynonyms will be longer if the two words rhyme (e.g., *loose-truce*) than if they do not rhyme (e.g., *loose-trust*) (Leiber, 1977; McCondry et al., 1979). This suggests that participants asked to process to a semantic level inadvertently process phonemic information. On the other hand, if subjects were asked to make visual identity decisions or rhyme decisions, latencies for negative decisions were not increased by semantic similarity (Baron & Henderson, 1978; Leiber, 1977; McCondry et al., 1979). Thus, it took no longer to respond *No* to *huge-large* than to *huge-lurch*. Similarly, if subjects were asked to make visual identity judgments, their decisions were not slowed by rhyme identity (Leiber, 1977, Expt. 1 & 2; McCondry et al., 1979). These findings have been interpreted as demonstrating that subjects can selectively encode *visual* information (read *structural*), ignoring phonemic and semantic information and can selectively encode phonemic information ignoring semantic information.

Again, there is an alternative explanation for these results. Decisions about visual identity might be made prior to phonemic and semantic code completion and decisions about phonemic identity may be made prior to semantic code completion. If this is the case, subjects are not restricting encoding to the relevant levels; it is simply that the higher level encoding process is of such duration that its completion occurs too late for semantic outputs to interfere with speeded decisions about lower level codes. Overall, data from this paradigm suggests that visual and phonemic information is encoded even when only semantic information is needed. They do not provide a definitive answer as to whether higher levels are encoded when only low level information is required.

In summary, all of the evidence (both pro and con) relevant to the issue of self-terminating processing is qualified by theoretical and/or methodological considerations. For example, it is unclear if many of the critical effects reported are results of processes occurring at encoding or at retrieval. In other studies, the methods and materials are sufficiently different from those used in the levels of processing task to make it unclear as to whether conclusions apply to the current issue. What is needed is a task that includes the standard methodology but allows one to make more justifiable inferences about processes which occur at the time of encoding.

Priming Effects and Codes

A more direct means of testing the self-terminating model would be to determine what levels of information are being activated during the encoding process. One possible way of achieving this end would be to use priming effects (Meyer & Schvaneveldt, 1971; Shulman, Hornak & Sanders, 1978) to infer what types of encodings have been activated. This method would involve presenting the levels orienting questions, a priming word and a subsequent target word. The relationship between the prime and the target word could be associative, rhyme, physical or neutral. One could assess the degree to which the orienting questions determine the level to which the priming word is processed by monitoring the efficacy of the priming word in facilitating subsequent lexical decisions about the target. A brief review of the relevant research results for associate, rhyme and physical primes seems appropriate before further explication of the method used in the present study.

Meyer and Schvaneveldt (1971) have demonstrated the presence of associative priming in a lexical decision task. In this study, subjects were presented two letter strings one above the other. The letter strings were two words, two pseudowords (letter strings which are orthographically legal, but are not words) or a word and a pseudoword. The subject's task was to press one button if the two letter strings were words (a positive response) and to press another button if one or both of the letter strings were pseudowords (a negative response). It was found that positive responses to associated words (e.g., *cat dog*) were faster than positive responses to nonassociates (e.g., *bread boy*). While it is logically possible for the priming effects to arise from direct connections between the structural or phonemic representations of associated words, a more appealing interpretation is that a semantic relationship underlies the associative priming effect. Schvaneveldt, Meyer and Becker (1976) have presented empirical support for this suggestion. They found that associative priming in a lexical decision task is dependent upon accessing the appropriate meaning of the words. For example, using the lexical decision task, they showed that a priming word (for example, *bank*) facilitated a lexical decision about an associated target word (for example, *teller*), when preceded by an appropriate context word but not when preceded by an inappropriate context word (for example, *river*). In other words, *money-bank-teller* led to priming for *teller* relative to a control (*table-car-teller*) but *river-bank-teller* did not lead to priming for *teller* relative to the control *table-car-teller*. Simpson (1981) has recently replicated this finding. Apparently, when the appropriate meaning of a word is accessed, the word can act as a prime for words that are associated to it; but when the inappropriate meaning is accessed, the word cannot act as a prime for words associated to it despite identical physical relationships. Furthermore, such priming does not apppear to depend upon concious expectancies (Neely, 1977; Tweedy, Lapinski, & Schvaneveldt, 1977).

Associative priming is not the only type of priming that occurs in a lexical decision task. A word can also be primed by a word that rhymes with it in both a lexical decision task (Meyer, Schvaneveldt, and Ruddy, 1974; Shulman et al. 1978; and Hillinger, 1980) and a Stroop task (Tanenhaus, Flannigan, and

Seidenberg, 1980).

Shulman et al. (1978) first showed that lexical decisions were faster for two words that rhyme (*reach teach*) than for two visually unrelated words (*bread couch*). As with semantic priming, Meyer et al. (1975) suggested that phonemic priming affects the encoding stage of processing. This phonemic priming is not necessarily mediated by higher level processing, however, since phonemic priming occurs for pseudoword pairs. That is, decisions are faster for two pseudowords that rhyme (*clame trame*) than for two that do not rhyme (*clame meach*) (Shulman et al., 1978). Although phonemic priming may not require accessing a semantic code, it should be dependent upon accessing a phonemic code. Results supporting this contention were obtained from Shulman et al. (1978). In this study, it was found that if the nonword distractors were pronouncable, the phonemic or rhyme prime effect occurred; but if the nonword distractors were not pronouncable, then decisions for rhyming words (*reach teach*) were not faster than decisions for visually similar words (*couch touch*). It appears that the presence of the pronouncable nonwords sets the subjects to activate a phonological code which is requisite for the rhyme priming effect.

In the same set of experiments, Shulman et al. (1978) demonstrated a third type of priming that seems to be based on structural similarity between words; that is, visually similar word pairs (*couch touch*) yielded shorter positive latencies than two unrelated words (*bread boy*). As noted before this result only occurred when unpronounceable nonwords were used as foils. Since no additional rhyme priming occurred, it seems that phonemic codes are not needed for structural priming to occur. Of course, it is of some interest that facilitative structural priming did not occur when pronounceable pseudowords were used as foils. In fact, in that situation both Shulman (1978) and Meyer et al. (1975) report interference effects for structural similarity. Both sets of investigators conclude that the structural similarity is such that the words look like rhymes(*couch touch*), therefore, subjects tend to activate inappropriate phonological codes for the second item. It is this inappropriate phonemic code that leads to the interference effect not the structural similarity per se.

A number of more recent results do not fit such a straightforward explanation. Hillinger (1980) replicated the rhyme priming effects of the above investigators but did not obtain interference effects for structural similarity. Tanenhaus, Flannigan and Seidenberg (1980) found, in a Stroop task, the rhyme relationship and structural relationship both produced interference effects. Within a Stroop paradigm such interference effects have generally been interpreted as an actual facilitation of encoding (Parkin, 1979; Warren, 1972). The fact that the word is encoded more rapidly in the primed situation lead to greater response competition. In other words, the interference effects in the Stroop task are thought to involve encoding processes in an identical manner to facilitation in the lexical decision task. Finally, a very recent study by Fowler, Wolfod, Slade and Tassinary (1981) found interference effects of structural similarity in a lexical task in a design that included no rhyming pairs.

Overall, the picture with respect to structural priming is far from clear; it produces results in both the lexical decison and Stroop task that are interpreted as facilitation of encoding. It also, in some instances, produces an interference effect in the lexical decision task. This effect has no clear cut interpretation. For the present study, it was hypothesized that structural primes which did not appear to be rhymes would be more likely to produce facilitory effects.

In summary, the preceding review of priming effects found in the literature yielded this pattern of results. (1) Associative priming is dependent upon processing the prime to a semantic level. (2) Phonemic priming is dependent upon processing the prime to a phonemic level but is not dependent upon processing to a semantic level. (3) Structural priming is dependent upon accessing a structured level, but facilitory effects are not dependent upon processing the prime to a deeper level. In fact, there is some suggestion that deeper processing may eliminate the facilitation.

A Methodology Concatenating Levels and Lexical Decision Tasks

As discussed previously, these findings suggest a method for looking at the activation of processing levels within a fraction of a second of presentation of a verbal stimulus. More to the point, priming effects provide a vehicle for examining the issue of self-terminating versus exhaustive processing during encoding within an incidental memory paradigm. Such a method would involve the presentation of two tasks in succession, each requiring the subject to make a decision about a single word. The subject would be required to make a levels orienting decision about the first word. The second word may be either related or unrelated to the first word in some specified manner (e.g., associative, rhyme, physical or neutral) If the levels orienting decision determines the level at which processing is halted, it will also determine whether the first word will facilitate processing of the second word. Subjects can make either semantic, phonemic or structural decisions about the prime. Three other researchers (Parkin, 1979; Smith, 1979 and Tor,1979) have all used variations of this methodology.

There are a number of assumptions implicit in the use of the proposed method. These assumptions have not been made explicit by other investigators, but at least the second seems particularly relevant to the interpretation of those studies as well as to the present study. These assumptions are as follows: (1) The type of code activated by perceptual processing is dependent upon the level at which a stimulus is processed. (2) Except for any facilitation in the encoding of the primed stimulus due to previous activation of related information by the prime, the manner in which the lexical item is processed is independent of the level of the preceding levels decision. (3) Any code activated for the prime during the levels decision will remain active for a relatively short interval, and still be a potent prime for the following item. (4) The activation of any code does not interfere with the continuing activation of any codes previously activated by processing at other levels. (5) Associative priming is dependent upon the activation of the appropriate semantic code for the prime. (6) Rhyme priming is dependent upon the activation for the appropriate phonemic code for the prime. (7) Structural priming is dependent upon the activation of the appropriate structural code for the prime.

There is no reliable empirical support for assumption 1 or 2. However, they are implicit assumptions of other researchers using this type of methodology. In particular, in regard to assumption 2, researchers have assumed that people will tend to use the same types of processes to do the same types of tasks, independent not only of what they have been doing in the previous five seconds, but also of earlier experimental trials. To more thoroughly investigate the validity of this assumption, the present study will include correlational analyses for levels and lexical latencies across both subjects and items, as indicators of possible inter-task interactions.

There is an empirical basis to assumption (3). This assumption is strongest in relation to semantic codes, as Meyer and Schvaneveldt (1976) have shown associative priming at ISI's of up to 5 sec. without any apparent rehearsal by the subjects. The argument for lower level codes is weaker. Evidence for the persistence of structural or phonemic codes is the finding of facilitory effects at a 1500 msec inter-stimulus-interval (ISI) (Fowler et al., 1981). The argument for the persistence of phonemic codes is also based on the finding of Hillinger (1980) that phonemic priming effects of equal magnitude were found with both simultaneous presentation of prime and target and with a 250 msec ISI between the prime and the target word.

Although all three types of priming have not been tested within one experiment, there is also some empirical evidence for assumption (4). Shulman et al. (1978) showed the simultaneous presence of associative and physical priming within one experiment. Phonemic and structural priming also have been demonstrated within the same experiment (Tanenhaus et al., 1981). The rationale and evidence supporting assumptions (5), (6) and (7) have been presented in previous sections.

Given the proposed procedure and outlined assumptions, a model incorporating self-terminating processing makes different predictions than an exhaustive model. For example, if a word is presented in the context of a structural orienting question and processing is self-terminating, then this levels decision word should prime only lexical decision words that are structurally related to it. In contrast, if processing is totally exhaustive, the levels decision word should also prime lexical decision words that are phonemically related to it and lexical decision words that are semantically related to it. Similarly, if a word is presented in the context of a phonemic orienting question and processing is self-terminating, then this word should prime lexical decision words that are phonemically related to it but not lexical decision words that are semantically related to it. A model of totally exhaustive processing predicts that a levels decision word will prime semantically related words no matter what type of orienting question is presented.

Obviously, patterns of results could be obtained other than those predicted by a self-terminating model with a strict temporal order of output or by an exhaustive model. Although this study was not explicitedly designed to test such model, some patterns of results might be better explained by a self-terminating interactive model or by a hybrid model (e.g., self-terminating at the structural level but not at the phonemic level).

Recently, three other investigators (Parkin, 1979; Smith, 1979 & Tor, 1979) have reported studies using variations of the method suggested here for determining whether processing may be terminated prior to the semantic level. The results of all three suggest the same conclusion: Processing is self-terminating prior to the semantic level. However, a close scrutiny of the studies suggests alternative explanations for each of the results.

The major differences between the study by Smith (1979) and the proposed study are: (1) Smith used only associative relationships, (2) the task used to measure the amount of facilitation was a letter search task rather than a lexical decision task, and (3) Smith did not use a semantic orienting condition. In her Experiment 1, Smith demonstrated that the time to find a letter within a word was decreased if the word was preceded by an associative prime. In Experiment 2, the priming effect disappeared if the subject also had to perform a letter search on the associative prime. Smith thus reached the conclusion that processing on this task was self-terminating.

An alternative interpretation of Smith's results is that the concatenation of the two letter search tasks may have changed the mode of processing in the second letter search task. For example, in the second task the subjects may have responded to features or attributes that were not affected by associate priming. Along this line Smith (1979) herself notes, that the result may be due to "some task specific interference." This would be a direct violation of the assumption that two concatenated tasks do not interact beyond the activation of information by the prime used in the encoding of the target. It appears that such a possibility should not be dismissed out of hand. Furthermore, although Smith (1979) found no effect of associative relationship on latency, associative relationship did lead to significantly lower error rates. It may very well be that the type of task demands led to a speed-accuracy trade-off.

There are also two methodological points that should be noted when interpreting Smith's results. First to be considered is the proven sensitivity of a lexical decision task to associative priming as opposed to a letter search task. While priming in a lexical decision task is a robust phenomenon demonstrated many times, Smith's demonstration of priming in a letter search task is the first to be published. Second, although Smith's study did demonstrate a lack of priming effects in a non-semantic orienting condition, combined with the presence of associative priming with no orienting task, she did not demonstrate priming following a semantic orienting task. It may be that the presentation of any orienting task disrupts associative priming. A proper assessment of the effects of a non-semantic orienting condition should include a semantic orienting condition.

Another study using a variation of the suggested methodology was reported by Tor (1979). Tor, however, used category primes instead of associative primes to test for semantic access and did not use structural or phonemic primes. In his study, as the first task of a trial, subjects made judgments about two simultaneously presented items. The type of judgment was one of physical identity, name identity, or category identity. The items could be either pictures or words. The second task in a trial involved either a lexical decision or pronouncing a word aloud. The stimulus words for the first task were either related by category or not related to the stimulus in the second task.

The results indicated an effect of category relation on pronounciation latency when the first task was a name or physical identity judgment about a picture. In no other condition was there a reliable effect of category relationship on second task latency. On the basis of these results, Tor concluded that the non-semantic tasks prohibited semantic processing. However, this conclusion of self-terminating processing for word stimuli is premature, considering that Tor did not demonstrate category priming for word primes in the semantic orienting condition. This lack of category priming is congruent with the finding of Becker (1980), that category primes are less effective as primes than are associates in a lexical decision task. Thus, the absence of a category prime effect may not be a valid indicator of the absence of automatic semantic access.

Parkin (1979) used a different variation of a priming methodology. In his Experiment 1, as the first task in each trial, subjects had to rate words on either the pleasantness of their meaning (semantic task) or the number of syllables they contained (non-semantic task). After a short interval the subjects were given a Stroop stimulus to name. That is, the subject was presented a word and was to name the color of ink in which the word was printed. The stimulus word for the first task was either an associate or nonassociate of the Stroop word. When the first task in the trial was the semantic orienting task, an associative relationship between that stimulus word and the following word significantly increased the Stroop effect. The non-semantic orienting task did not lead to increased interference. Similar results were obtained in a second experiment using a living-nonliving category decision as the semantic task. Parkin (1979) concluded that non-semantic orienting tasks may have stopped processing at a pre-semantic level.

A different interpretation is that the non-semantic task may have led to semantic activation, but this activation decayed more rapidly than following a semantic orienting task. It would seem worthwhile to pursue this line of investigation with a shorter ISI than that used by Parkin. A second alternative is that the Stroop task is not sufficiently sensitive to detect any automatic activation of a preceding prime word. A lexical decision task has been shown to be sensitive to automatic activation of semantic information (Neely, 1977) and thus may be a more appropriate task to test for such an effect.

Five points that have come to light in the discussion of the previous studies were specifically taken into account in the design of the present study. First, given the robustness of priming effects manifested with a lexical decision task, this task would seem optimal to test for priming effects. Second, associatively related prime-target item pairs shown to be effective in a standard priming paradigm should be used to test semantic access. Third, both semantic and non-semantic orienting tasks should be used within an experimental test. Fourth, given Parkin's results, it appears preferable to use an ISI shorter than 1100 msec. Fifth, it is appropriate to examine non-semantic priming, both structural and phonemic, and to determine whether they covary with the presence or absence of associate priming. None of the preceding studies met all these criteria.

To reiterate, the present method involves concatenating two tasks. A levels orienting question was presented, then the word about which the orienting decision was to be made. This word was followed by a letter string which was either a word or a pseudoword. It if was a word, it was related to the preceding levels decision word in one of four-ways: (1) associatively related (e.g., *cat dog*); (2) rhyme related (e.g., *reach teach*); (3) structurally related (e.g., *bus but*); or (4) neutral or unrelated (e.g., *last cut*).

Method

Design

The basic design was a three by four factorial. The level of the orienting question (semantic, phonemic and structural) was a between-subjects variable crossed with the four kinds of relationships between the levels decision word and the lexical word (Associate, Rhyme, Physical and Neutral) which was a within-subjects factor. Each lexical item appeared twice, once following a levels *Yes* decision and once following a levels No decision. Thus both Decision type (*Yes* and No) and Order (First and Second) were within subject factors and were crossed with Level and Relationship, but a priori, were thought to be of less theoretical interest.

There were also three separate control groups: Lexical Alone, Prime Alone and Double Prime. The Lexical Alone group had the lexical items presented in isolation and was a control for sampling error. The Prime Alone group had the levels word and the lexical item presented with no orienting question. This condition is identical to the traditional priming procedure. In the Double Prime group, the items presented were the same as in the Semantic condition. However, in the Double Prime condition no levels decision was required of the subject. This condition was included to assess the effects of simply presenting a category name prior to the levels item. All three of these control groups had the same within subject conditions as the three Standard Levels conditions. In all three, however, the Decision Type factor was a dummy factor in that the S's made no Levels decision. In the Lexical Alone condition, Relationship was also a dummy factor because no levels items were presented.

Materials

Levels Words. The type of orienting question asked varied between groups. The levels item to which these questions applied were the same for all three orienting groups. All these levels words were drawn from Battig and Montague's (1969) norms. Six levels words were chosen from each of 28 categories. These were the six most commonly given members in each category with the restrictions that: (a) they contained no more than seven letters, (b) they rhymed with an English word and (c) their category related meaning was their clearly dominant meaning. Dominance in this case was defined in a free associate task as at least 90% of 40 respondents giving, as a primary associate, a word that was related to the category related meaning of the stimulus word. Eight words did not reach this criterion.

Some preliminary work indicated that two of the twenty-eight categories led to particularly high latencies for some of the items. These two categories were omitted from scoring for all dependent measures. They were left in the presentation order for purposes of counter-balancing.

Levels-Lexical Relationships. The 168 levels words were used to generate six types of levels-lexical relationships. Each levels word was paired with a specific lexical item (word or pseudoword) such that the levels-lexical relationship for that pair was constant across all groups. The six types of relationships between Levels and Lexical items are shown in the last two columns of category 1 in Appendix A. They will be referred to as: (a) Associative: The levels and lexical words within each pair were associatively related. (b) Rhyme: The levels and lexical words within each pair rhymed. (c) Physical: The levels and lexical words within each pair were structurally similar. (d) Neutral: There was no obvious relationship between the levels word and the lexical item. (e) Pseudoword: The pseudoword presented as the lexical item had no apparent relationship to the preceding levels word. (f) Rhyming Pseudoword: The pseudoword presented as the lexical item rhymed with the preceding levels word. The specific procedures by which the levels-lexical pairs were created are described in subsequent sections.

Associative Relationship Pairs. The lexical words for the associative pairs were generated by an associate production method. The general method and instructions were taken from Jenkins (1970). Forty subjects were presented each of the 168 category members in random order and asked to write down the first word that each brought to mind. For each of the 168 words the primary associates produced to a particular word were ordered as to the number of times they were produced to that word (to a maximum of 40 since there were 40 subjects). Within each category the word that was given most often to its appropriate levels word was used in the levels-lexical associative pair for that particular category providing (a) it was seven letters or less in length, (b) the word did not appear elsewhere in the materials, (c) that the basis of the associated word appeared to be the category related meaning of the preceding levels word's dominant meaning and that meaning appeared to be the basis of the association, and (d) the word was not a member of the particular category as per Battig and Montague's (1969) norms. If the most frequently given associate did not meet these criteria, the next most frequently given associate that met these criteria was used. If one of the first two associates not been accepted, the fourth criterion (d) was relaxed. This occurred five times in 28. In this manner, 28 words (one per category) were selected as the lexical word for the associatively related levels-lexical pairings. The mean associative production frequency of the words selected was 13.6 words out of 40.

Rhyme Relationship Pairs. The 28 lexical words for the levels-lexical rhyme pairs were experimenter chosen (one per category) from rhymes with the restrictions that (a) the words did not appear elsewhere in the materials, (b) rhymes were based on a highly dominant pronounciation, (c) they were matched approximately to the lexical words of the associative pairs on mean frequency of occurrence in written text (Kucera & Francis, 1967), (d) they were matched approximately to the lexical words of the associative pairs on mean number of letters, (e) the levels words that were used for these pairs were approximately matched to the levels words that were used in associatively related pairs on: (1) mean ordinal goodness of category membership.(This measure was derived simply by ordering the six levels words within each category as determined by Battig and Montague's (1969) norms), (2) category production frequency (i.e., Battig & Montague, 1969), (3) and on mean number of letters, (f) one-half of the lexical words had the same vowel structure and final consonant as their preceding rhyme (visually similar), e.g., *"reach teach"*, and one-half had different vowel structure and/or final consonants than their rhymes (visually dissimilar), e.g., "*shirt hurt*". All of the visually similar rhymes shared at least 66 percent of their letters in common. All but three of the visually dissimilar shared 50 percent or less.

Physical Relationship Pairs. The 28 lexical words for the levels-lexical physical pairs were produced in the following way. First, a physical relationship was defined as the lexical word having at least sixty percent of its letters in common and the same first letter as its corresponding levels word. In most cases these words shared at least seventy-five percent of their letters and all but two had the same number of letters. These words were experimenter generated, one for each category, with the added restrictions, (a) to (e), that applied to the rhyme relationship lexical words.

Neutral Relationship Pairs. A neutral relationship was defined as an absence of any perceived consistent relationship between the lexical words and their corresponding levels words. Those words were experimenter generated (one from each category) using wherever possible words from the unused associates with the restrictions, (a) to (e), that applied to both the rhyme and the structural relationship lexical words.

Pseudoword and Rhyming Pseudoword Levels-Lexical Pairings. The pseudoword pairs were constructed by changing a single letter in the words used in other conditions to create 39 pronounceable nonwords. The 13 rhyming pseudowords for the rhyming pseudoword pairs were constructed by producing a word of seven or fewer letters that rhymed with the relevant levels word, then changing one letter to create a nonword that rhymed with the relevant levels word. With all the foregoing restrictions on the word stimuli for lexical decisions, it was not possible to match the pseudowords and rhyming pseudowords to the words on all the various attributes of the preceding levels words. The particular levels words were randomly chosen as to whether they would precede an unrelated or a rhyming pseudoword. There were two nonword trials for each category, at least one of which was an unrelated pseudoword.

Levels Questions. The design was such that each of the 168 levels-lexical pairs would appear once following a levels question for which a positive response would be correct and once following a levels question which should lead to a negative response. All conditions and stimuli appear in Appendix A.

Stimuli for the 168 positive trials for the semantic level were formed by preceding each of the six levels-lexical pairs, from each of the 28 categories, by the appropriate category name with a question mark above it. The 168 stimuli for the negative semantic decisions consisted of each of the six levels-lexical pairs, for all 28 categories, preceded by an inappropriate category name. The inappropriate category name was randomly chosen from the remaining 27 inappropriate categories with the restriction that each of the 28 category names appeared six times as semantic questions on trials for which a negative response was correct. Refer to the list of stimulus materials in Appendix A.

The stimuli for the phonemic questions leading to 168 positive phonemic levels decisions were formed by generating a rhyme for each of the 168 level words with the restrictions that: (a) none of these rhymes appeared elsewhere as levels words or lexical words, (b) that these rhyme words had one highly dominant pronounciation, (c) that these words were matched for both number of letters and frequency of occurrence (Kucera & Francis, 1967) across each of the levels-lexical relationships, and (d) the levels-lexical pairs were matched for the total number of visually similar and dissimilar rhyming pairs within each of the levels-lexical relationships.

The 168 stimulus strings for negative (non-rhyming) phonemic trials were formed by pairing 168 words of seven or fewer letters, which did not appear elsewhere in the materials, with the levels words. Frequency and number of letters were matched within each of the levels-lexical relationships.

The 168 stimulus strings, for the structural level questions leading to positive decisions, were produced by randomly picking a letter from each of the 168 levels words with the restriction that the letter had appeared in the first, last or middle letter position, on approximately equal number of times for each levels-lexical relationship. Also, the letter had an equal chance of appearing in the lexical items across each of the levels-lexical relationship. The negative structural levels-lexical strings were formed by randomly re-pairing the structural questions with the levels-lexical pairs, with the restriction that the letter did not appear in the levels word.

The difference between the Double Prime group and the Semantic group was in the procedure, not in the stimuli. For the Prime Alone condition, no levels questions preceded the presentation of the levels word strings. For the Lexical Alone condition there was no levels question nor levels word.

The instructions for the subjects for the levels and lexical decision task appear in Appendix B. All stimulus words and letters were displayed on a video screen and subtended a visual angle of one degree and three degrees.

Apparatus

The stimulus presentations were controlled by an HP9825 computer and displayed through an HP1350A Graphics Translator on an HP1304A CRT equipped with P15 phosphor. Subjects looked through a tunnel at the display and made responses by pressing digital response keys.

General Procedure

The HP9825 was used to generate eight sequences of presentation that were random except for the restrictions that: (1) for each of the six types of levels-lexical pairings the n+1 string could not be presented until the nth string had been shown for each of the other five types; (2) each lexical item appeared only once in the first half of the trials and once in the second half of the trials, and (3) for each type of levels-lexical relationship, 14 items appeared as *Yes* decisions to the levels question in the first half, and 14 in the second half of the 336 trials.

Sequences 9 to 16 were the reverse of sequences 1 to 8. This meant that for each levels item, first or second presentation by positive or negative levels decision was counterbalanced across the 16 sequences.

Each of the 16 sequences was used once within each levels condition. The instructions for each of the conditions are shown in Appendix C. For all conditions the experimenter stressed that subjects were to be accurate and then were to respond as quickly as possible.

The series of events on a single trial was as follows. The screen showed a centrally located fixation point. The subject pressed the START button. After 500 milliseconds, the levels orienting question appeared on the screen at the fixation point for 750 msec, then after 500 msec, the levels word was presented in the same position until the subject responded. After another 500 msec, the lexical stimulus appeared at the fixation point until the subject responded. The sequence was ended by the subject's response and another trial was initiated as soon as the subject pressed the START button.

For all the control conditions the stimuli presented were shown in the same location as in the standard orienting questions. On the Double Prime control trials, 500 msec after fixation, the semantic orienting question appeared for 500 msec. After another 500 msec the levels word appeared for 850 msec[1], but the subject did not respond to it. After another 500 msec, the lexical item appeared. The participant made a lexical decision for this item. On the Prime Alone trials, 500 msec after fixation the prime appeared for 850 msec. Again the subject did not respond. After another 500 msec interval, the lexical item appeared for which the subject made a lexical decision. For the Lexical Alone condition, the lexical item appeared 500 msec after the fixation point. In all conditions the lexical item remained on until the participant responded.

Recall Measures and Subject Expectancies

After finishing the reaction time tasks, all subjects were given a two minute intervening arithmetic task, adding up columns of numbers. Then they were given an unexpected recall test for both the levels and lexical words. Instructions appear in Appendix D. Finally, all of the subjects were given two questions, to test (1) their awareness of any relationships between the levels and lexical words, and (2) the percentage of trials on which they estimated these relationships occurred. These questions appear in Appendix F.

Subjects

Subjects were volunteers from Introductory Psychology who received credit towards their course for experimental participation. There were 16 subjects for each of the six between subject factors.[2]

Subjects were randomly assigned to the three standard orienting conditions. All of the three control conditions were run individually prior to the standard orienting conditions, and subjects were assigned by the time slot they volunteered for.

Results

Deletion of Extreme Scores.

Analyses of pilot data had shown a number of very long or outlying reaction times. Subjects' comments indicated many of these occurred when they became confused or distracted. Thus, these measures may not reflect normal processing of levels or lexical decisions. On this basis it was decided to eliminate, iteratively, all scores from a particular condition that fell more than two and one-half standard deviations from the mean for that condition. If a levels or lexical score was eliminated, the corresponding lexical or levels score was also eliminated prior to the analyses of the latency data.

The percent deleted were analyzed by analyses of variance, treating subjects as a random effect. As in all the analyses, words were treated as a fixed effect because of the high constraint on the selection of stimuli. The data for word trials were analyzed separately from that for pseudoword trials.

For each of the three control groups,(Double Prime, Prime Alone and Lexical Alone), the data for word trials were analyzed by a 2 (Decision Type) by 4 (Relationship) repeated measures analysis. This data appears in Appendix G. The data for pseudoword trials were analyzed by Decision Type. This data appears in Appendix H. There were no significant differences for these analyses. In all cases, percent deleted was less three percent.

The word data for the three standard orienting groups were analyzed by a 3 (Level) by 2 (Decision Type) by 4 (Relationship). The data for lexical decision items appear in Appendix I. There was a significant effect of Decision Type, $F\ (1,45)=8.4$, $MSe = 12.8$, $p < .01$. Fewer lexical items were deleted after levels *Yes* decisions than after levels *No* decisions. The difference was relatively small, (2.2 vs. 3.3), and no attempt was made to interpret it. For all cells, percent deleted was less than four percent.

For levels items, in the three standard orienting groups, the analysis of the data for word trials, Appendix J, showed a significant effect of Relationship, F (3,135)=3.7, *MSe* = 6.6, $p < .05$. The percent deleted for the Associative, Rhyme, Physical and Neutral items was 2.8, 3.0, 3.5 and 3.6 respectively. Again, there was no apparent reason for this small but significant difference. In no cell was more than four percent deleted.

The percent deleted in the three standard orienting conditions on pseudoword trials for both lexical and levels items appear in Appendix K. The analysis of the lexical items showed that more pseudowords were deleted following *Yes* decisions (2.9) than following *No* decisions (1.8), F = 6.6, *MSe* = 4.6, $p < .05$. There was a trend for this effect to be greatest for the phonemic group. In no cell was more than four percent deleted.

Analysis of Latency and Recall Data

The main theoretical issue concerned the effect of the three types of standard orienting questions on priming effects. However, the Double Prime, Prime Alone and Lexical Alone conditions were required as baseline or control conditions. The conditions were run prior to the other conditions and the data subjected to separate analyses.

Unless stated otherwise, all analyses of variance had all the factors, other than levels, as repeated measures nested within levels. For the analyses including levels, levels was a between groups factor. Unless stated otherwise, following Kirk

(1968), all *post hoc* comparisons between individual means were performed using the Tukey HSN test. Comparisons involving more than two means used Scheffe's test.

The latency and error rate data will be reported in the following order. First, the data and analyses relating to the four priming types of relationships between the levels words and the lexical words will be presented. Next some correlational analyses of corresponding levels and lexical latencies across subjects and across items will be reported. The analyses of the recall data will follow the latency data results for the four standard relationships. After the recall analyses, the analyses of the subjects' awareness of the the various relationships will be presented. The analyses of data relevant to the two types of rhyme relationships will be described. Finally, the analyses of the data pertinent to nonword trials will be reported.

Throughout the analyses of the latency and the error data, there were a number of occasions in which the error rates were significant. In none of these was there evidence of a speed-accuracy trade-off. In most cases, the pattern for the latency and the error rate data was identical. Generally, error rate analyses will not appear in the text but the data are presented in the Tables and the analyses will appear in the Appendices.

The Order of Presentation factor interacted with other factors in an interesting way in only one analysis. Given this consideration, and in order to simplify the presentation of all the data, the major tables will present the data averaged over first and second presentations.

Control Groups: Lexical Decision on Word Trials

The raw data for the analyses of the lexical decision data were subject means. For the control groups these data were analyzed in a 2 (Order) by 2 (Decision Type) by 4 (Relationship) repeated mesures ANOVA. For the standard orienting groups, Level (Semantic, Phonemic, Structural) was included as a between groups factor.

Throughout the results, I will refer to priming effects. A priming effect simply refers to a significant difference between the Neutral Relationship mean and one of the other three Relationships (Associative, Rhyme or Physical). Thus, for example, a facilitory associative priming effect occurs when the mean latency for the associative cell is shorter than the mean latency for the corresponding neutral cell. An associative interference priming effect occurs when the mean latency for the associative cell is greater than that for the corresponding neutral cell.

The data for the three control groups for word trials is shown in Table 1a. The primary purpose of the analysis of the Lexical Alone data was to assure that the items in the various relationships did not differ in mean latencies when they were not preceded by the relevant prime word.

Table 1 a

Mean Latencies in Milliseconds for Correct Word Decisions, as a Function of Levels-Lexical Relationships in the Control Conditions

Relationship	Decision Type	Level		
		Lexical Alone	Prime Alone	Double Prime
Associative	Yes	602 (1.0)	554 (0.0)	571 (0.2)
	No	612 (1.6)	556 (0.7)	564 (0.0)
	$\overline{X}$	607 (1.3)	555 (0.3)	568 (0.1)
Rhyme	Yes	603 (2.2)	593 (4.0)	619 (3.8)
	No	622 (1.7)	587 (2.4)	602 (3.1)
	$\overline{X}$	613 (2.0)	590 (3.4)	611 (3.5)
Physical	Yes	602 (3.7)	611 (2.4)	606 (6.3)
	No	599 (2.3)	615 (1.7)	606 (2.6)
	$\overline{X}$	601 (3.0)	613 (2.3)	606 (4.5)

(continued)

Table 1a (continued)

Mean Latencies in Milliseconds for Correct Word Decisions, as a Function of Levels-Lexical Relationships in the Control Conditions

Relationship	Decision Type	Level		
		Lexical Alone	Prime Alone	Double Prime
	Yes	602 (1.2)	600 (2.2)	608 (3.1)
Neutral	No	600 (1.0)	603 (1.3)	602 (2.6)
	$\overline{X}$	601 (1.1)	602 (1.8)	605 (2.9)
	Yes	602 (2.0)	589 (2.3)	601 (3.0)
Mean	No	608 (1.7)	590 (1.6)	593 (1.9)
	$\overline{X}$	605 (1.9)	590 (1.9)	

Note. Percent errors shown in parentheses.

Table 1b

Priming Effects Across Control Conditions

Relationship	Decision Type	Level		
		Lexical Alone	Prime Alone	Double Prime
Associative	Yes	0	46	37
	No	-12	47	37
	$\overline{X}$	-6	47	37
Rhyme	Yes	-1	7	-11
	No	-22	16	0
	$\overline{X}$	-12	12	-6
Physical	Yes	0	-11	2
	No	0	-12	-4
	$\overline{X}$	1	-12	-1

For the Lexical Alone control condition, there were no significant differences between mean latencies (all $p > .10$), except for the factor of presentation order, (first versus second), *F* (1,15) = 4.4, *MSe* = 7586, p = .05. Latencies were shorter for second than for first presentation (594 msec vs. 617 msec). This indicates that the matching of items on various attributes of words was successful in producing sets of items, for each Relationship, which were approximately matched in difficulty for the lexical decision task.

The major reason for analyzing the Prime Alone condition was to determine the priming effects that occur in the absence of a levels decision. This analysis showed a main effect of Relationship, *F* (3,45) = 17.7, *MSe* = 2286, *p* < .01. *Post hoc* comparisons showed that there was a significant priming effect of 47 msec for associates but no effect for any other relationship. This indicates that the set of associates chosen were of adequate associative strength to produce a reliable priming effect of a magnitude consistent with those reported in the literature. The only other significant effect was an effect of Order upon latency. Second presentations of words led to significantly faster responses than did first presentations (565 msec vs. 615 msec), *F* (1,15) = 15.7, *MSe* = 10346, *p* < .01.

It was somewhat surprising that there was no evidence of either a rhyme or a physical priming effect in the Prime Alone condition. This is in direct conflict with a number of published studies (Meyer, Ruddy & Schvaneveldt, 1974; Shulman et al., 1978; Tanenhaus et al.,1980 & Hillinger, 1980).

The goal of the analysis of the Double Prime condition was to assess the effect of presenting a levels question prior to the presentation of the levels word. In contrast to the three standard orienting conditions no levels decision was required. This group showed virtually the same results as the Prime Alone condition. For the latency data, there was a significant effect of Relationship, F (3,42) = 8.6, MSe = 2731, $p < .01$. Associates were responded to more quickly than other items. Again, the second presented items were responded to more quickly than the first presented items (575 msec. vs. 619). Overall, there was no evidence that the presentation of an additional word prior to the prime changed the pattern of results obtained in the Prime Alone condition.

In summary, the major points of interest from the analyses of the control conditions were the presence of associative priming in the Prime Alone condition and the Double Prime condition. The absence of any consistent effects in the Lexical Alone condition indicated that the various factors assumed related to latency were adequately controlled.

Standard Orienting Groups: Levels Decisions

For the three orienting groups, the analyses of the levels decisions will always precede the analyses of the lexical data. For the analyses of the levels decisions, Relationship was considered a pseudo-variable because it is determined by the relationship between the levels word and the subsequently appearing lexical item. Since relationships, from the subject's perspective, are not apparent until the presentation of the lexical item there should not be an effect of relationship upon the first presentation of a levels item. It is possible that there could be an effect of Relationship upon the second presentation of a particular levels-lexical pair mediated by long term memory effects. However, in general, these analyses should be considered as tests for sampling error.

The data for the levels decisions appear in Table 2. The analyses of the latency data produced only one significant effect of note. This was the interaction of Levels with Relationship, *F* (6,135) = 3.2, *MSe* = 5425, *p* < .01. This two-way interaction was analyzed by looking at the simple effects of relationship within each group. There was no effect of relationship for the Semantic group. Within the Phonemic group there was a significant effect, *F* (3,135)=2.95, *MSe* = 5425, *p* < .05. Latencies for levels decisions were longer for levels words in the associative relationship than in the other three relationships. This was of some concern in that this 29 msec difference may reflect that the phonemic decisions tended to be harder prior to associative relationship words. However, the relatively small size of the difference alleviated some of this concern. Furthermore, subsequent analyses,[34] to be reported later in the text,

Table 2

Mean Latency in Milliseconds For Correct Levels Decisions

Relationship	Decision Type	Levels			
		Semantic	Phonemic	Structural	Mean
Associative	Yes	760 (3.7)	768 (4.8)	700 (3.7)	742 (4.1)
	No	862 (7.4)	855 (4.1)	828 (4.7)	848 (5.4)
	$\overline{X}$	811 (5.6)	812 (4.5)	764 (4.2)	795 (4.8)
Rhyme	Yes	763 (3.2)	729 (4.0)	729 (4.3)	740 (3.8)
	No	851 (6.9)	824 (4.5)	839 (5.0)	838 (5.5)
	$\overline{X}$	807 (5.1)	776 (4.3)	784 (4.7)	789 (4.7)
Physical	Yes	752 (4.4)	749 (2.3)	782 (5.1)	761 (3.9)
	No	855 (5.4)	818 (4.6)	800 (3.8)	830 (4.6)
	$\overline{X}$	804 (4.9)	784 (3.4)	797 (4.5)	796 (4.2)

(continued)

Table 2 (continued)

Mean Latency in Milliseconds For Correct Levels Decisions

		Semantic	Phonemic	Structural	Mean
Neutral	Yes	739 (4.2)	738 (2.6)	703 (3.7)	727 (3.5)
	No	879 (6.7)	825 (4.2)	805 (5.3)	837 (5.4)
	$\overline{X}$	809 (5.4)	782 (3.4)	754 (4.5)	782 (4.4)
Mean	Yes	754 (3.9)	746 (3.4)	728 (4.2)	743 (3.8)
	No	862 (6.6)	831 (4.4)	822 (4.7)	838 (5.2)
	$\overline{X}$	807 (5.2)	789 (3.9)	775 (4.4)	

Note. Percent errors shown in parentheses.

further explored the possibility that this confound was serious and found nothing to support this contention.

Again, in the Structural level, there was an effect of Relationship, *F* (3,135)=4.86, ***MSe*** = 5425, *p* < .01. Latencies were longer for the levels words in the physical and rhyme relationships than in the neutral and associative relationships. This effect did not covary in any obvious way with lexical decision latency[4] but should be considered when interpreting the latencies for lexical decisions.

The other significant effects were a main effect of Order, *F* (1,45) = 48.0, ***MSe*** = 20428 *p* < .01, with items presented second (754 msec) being responded to more quickly than items presented first (826 msec), and an effect of Decision Type, *F* (1,45) = 72.5, ***MSe*** = 24206, *p* < .01. This latter effect reflected the fact that *Yes* levels responses were made more quickly than were No responses. Both these results are consistent with previously reported results.

Overall, the analyses of the Levels data gave some evidence of sampling error for the levels items which should be considered in interpreting the effects of interest on the lexical decision data.

Standard Orienting Groups: Lexical Decisions on Word Trials

The analyses of most interest concerned the amount of priming in the three standard levels conditions. The means for these analyses are shown in Table 3(a). The calculated priming effects appear in Table 3(b). An important result was the scant evidence of the any effect of associative relationship.[34] This was particularly unexpected in the Semantic condition. Two other results relevant to the issue of self-terminating processing were the two-way interaction of Decision Type with Relationship, *F* (3,135) = 9.0, *MSe* = 5260, $p < .01$, and the three-way interaction of Level with Decision Type with Relationship, *F* (6,135) = 2.6, *MSe* = 5260, $p < .05$.

The two-way interaction reflects that the rhyme relationship yielded a significant facilitory effect following *Yes* decisions, combined with an interference effect following No decisions. The physical relationship showed a significant interference effect after Levels *No* decisions, combined with a nonsignificant trend towards a facilitory effect following *Yes* decisions. If one combines all three types of relationships, and compares them to the neutral condition, the result is a significant two-way interaction, indicating that responses for the related items tend to be faster following Levels *Yes* decision, and slower following Levels *No* decisions.

This two-way interaction should be interpreted within the context of a reliable three-way interaction of Level by Decision Type by Relationship. This three-way interaction was analyzed as simple effect two-way interactions within each levels group. There was no interaction of Decision Type with Relationship for the Semantic group, but there was such an interaction for the

Table 3 a

Mean Latencies in Milliseconds for Correct Word Decisions as a Function of Levels-Lexical Relationships in the Standard Levels Decisions.

Relationship	Decision Type	Level			
		Semantic	Phonemic	Structural	Mean
Associative	Yes	717 (2.4)	750 (4.3)	684 (3.9)	717 (3.5)
	No	716 (0.3)	714 (1.1)	637 (0.0)	689 (0.4)
	$\overline{X}$	716 (1.3)	732 (2.7)	661 (2.0)	703 (2.0)
Rhyme	Yes	736 (4.1)	692 (2.7)	663 (3.7)	697 (3.5)
	No	706 (3.2)	754 (2.9)	665 (1.0)	709 (2.4)
	$\overline{X}$	721 (2.8)	724 (2.8)	664 (2.4)	703 (3.0)
Physical	Yes	719 (3.0)	752 (5.9)	671 (3.2)	715 (4.1)
	No	726 (2.4)	744 (3.1)	654 (1.0)	708 (2.2)
	$\overline{X}$	722 (2.7)	748 (4.5)	663 (2.1)	711 (3.1)

(continued)

Table 3 a (continued)

Mean Latencies in Milliseconds for Correct Word Decisions as a Function of Levels-Lexical Relationships in the Standard Levels Decisions.

Relationship	Decision Type	Level			
		Semantic	Phonemic	Structural	Mean
Neutral	Yes	724 (6.4)	773 (6.1)	721 (3.6)	739 (5.4)
	No	679 (1.1)	708 (0.6)	648 (0.8)	678 (0.8)
	$\overline{X}$	701 (3.8)	741 (3.4)	685 (2.2)	704 (3.1)
Mean	Yes	724 (4.0)	742 (4.8)	685 (3.6)	717 (4.1)
	No	706 (1.8)	730 (1.9)	651 (0.7)	696 (1.5)
	$\overline{X}$	715 (2.9)	736 (3.3)	668 (2.2)	

Note. Percent errors shown in parentheses.

Table 3 b

Priming Effects Across Various Levels Conditions

Relationship	Decision Type	Level		
		Semantic	Phonemic	Structural
Associative	Yes	7	23	37
	No	-37	-6	11
	$\overline{X}$	-15	9	24
Rhyme	Yes	-12	81	58
	No	-27	-46	-17
	$\overline{X}$	-20	+18	+21
Physical	Yes	5	21	50
	No	-47	-36	-6
	$\overline{X}$	-21	-8	+22

Phonemic group; F (3,135)=9.0, MSe = 47184, $p < .01$; and for the Structural Group F (3,135)= 3.42, MSe = 18016, $p < .05$.

The two-way interaction within the Phonemic group as its primary component, showed that for the rhyme relationship there was a significant facilitory effect following *Yes* decisions and an interference effect following *No* decisions. The primary components of the two-way interaction within the structural group were significant facilitory effects of rhyme and physical relationships following levels *Yes* decisions. There was also a trend for latencies to be shorter for associative relationship items than for neutral items following levels *Yes* decisions, (11 of 16 subjects showed a trend in that direction; q = 2.9, $p<.10$)

In summary, the three-way interaction and auxilliary analyses indicated that within the Phonemic group for the rhyme relationship, there was a significant facilitory effect following *Yes* decisions, and an interference effect following *No* decisions. In the Structural, group there were facilitory effects of Rhyme and Physical relationships following *Yes* decisions. Both these findings suggest that the structural and phonemic processing temporarily maintains low level codes when a positive levels decision is made. The presence of rhyme priming in the Structural group indicates processing in this group continued beyond the Structural level. Overall, there was no statistically reliable evidence of associative priming, although there was trend in that direction following Structural *Yes* decisions.

A noteworthy finding was that Levels condition interacted with Order, *F* (2,45) = 4.0, *MSe* = 14518, $p < .05$, in such a way that there was a trend for first-second differences to be largest for Semantic, next largest for Phonemic, and smallest for Structural condition (103 msec vs. 69 msec vs. 42 msec).

This suggests that in the Semantic group, lexical activation was better maintained than in the two lower level conditions. This, in turn, implies that the lexical decision process is not independent of the preceding levels orienting task. Perhaps, following a semantic levels decision, lexical decisions are more dependent upon a semantic code.

Other less theoretically interesting, but statistically reliable results for the lexical decision latencies included: (1) latencies were shorter to second presentations of items than to first presentation of items, *F* (1,45) = 67.5, *MSe* = 14518, $p < .01$ (671 msec vs. 742 msec) and (2) latencies were shorter following levels *No* decisions than levels *Yes* decisions, *F* (1,45) = 6.0, *MSe* = 14507, $p < .05$.

To reiterate, the important findings for the analyses of the lexical decision data for the standard orienting conditions were: (1) a facilitory effect of rhyme priming following Phonemic levels *Yes* decisions, (2) facilitory effects of physical and rhyme priming in the Structural condition following *Yes* decisions, (3) little evidence of associative facilitation which suggested that the effect, if present, was greatest in the

Structural condition, and least in the Semantic condition; (4) lexical decision latencies in the Semantic group decremented more from the first to the second presentation than in the other two conditions.

Median Split on Levels: Lexical Decision Reaction Times

The fact that there was no reliable associative priming effect might be due to the length of the inter-stimulus-interval (ISI) used in this study. Parkin (1979), who did report associative effects following Semantic orienting questions, used an ISI of 1100 msec (Expt. 1). While there is no direct evidence linking ISI to the magnitude of the priming effects, the difference between ISI's in the present study and in Parkin's study also created differences in stimulus onset asynchrony (SOA). Neely (1977) has shown priming effects to be influenced by SOA. In the present experiment SOA between Levels and Lexical items was not directly manipulated. However, it did vary as a function of how long the subject took to respond to the Levels item. That is, subjects who were slower on the levels items had longer levels-lexical SOA's.

As an exploratory analysis, subjects were divided into fast and slow groups using a median split on overall levels latencies within each group. These scores were used in an overall analysis of Speed (fast, slow), Level, Order, Decision Type, and Relationship. For the Lexical latencies there were no reliable and interesting effects, although the interaction of speed by level approached significance. *F* (2,42)= 3.1 *MSe* = 120771 $p <$ .06. The trend indicated that in the Semantic condition, subjects who were fast on their levels decisions were also faster on the Lexical decisions. This difference did not occur for the other groups.

Despite the fact that the fast versus slow responder variable did not interact with any other variable of interest in the overall analysis of latency data, effects for each level were evaluated separately for both the fast and the slow responders. The means for these analyses for the lexical decision latencies and their related error rates are reported in Tables 4 and 5 .

Semantic Level. The fast responders in the semantic group showed the expected effect of order, *F* = 36.9, *MSe* = 7819, $p <$ .01. There was also an interesting interaction of Decision Type with Relationship, *F* (3,21) = 4.3, *MSe* = 1926, $p < .05$. This reflected a trend for decisions to associated words to be faster than those to neutral items following Semantic *Yes* decisions, and the reverse was true following *No* decisions. For the slow subjects there were no significant effects. A possible interpretation of the trend for fast subjects to show associative priming will be explored more fully in a subsequent section.

Phonemic Level. The fast responders in the phonemic group showed no significant effects. Although they did not differ in the pattern of means, the slow subjects showed two significant effects. First, there was a significant effect of Order, *F* (1,7)

Table 4

Mean Latencies in Milliseconds for Correct Word Decisions for Fast Subjects as a Function of Levels-Lexical Relationships: Standard Orienting Conditions

Relationship	Decision Type	Level		
		Semantic	Phonemic	Structural
Associative	Yes	613 (2.7)	735 (6.0)	692 (4.6)
	No	630 (0.5)	686 (1.6)	609 (0.0)
	$\overline{X}$	622 (1.6)	710 (3.8)	651 (2.3)
Rhyme	Yes	657 (4.6)	672 (3.3)	675 (5.9)
	No	619 (4.2)	704 (4.2)	650 (1.5)
	$\overline{X}$	638 (4.4)	688 (4.2)	663 (3.7)
Physical	Yes	650 (5.1)	719 (8.3)	670 (4.3)
	No	652 (4.3)	687 (3.0)	631 (1.5)
	$\overline{X}$	651 (4.7)	703 (5.7)	652 (2.9)

(continued)

Table 4 (continued)

Mean Latencies in Milliseconds for Correct Word Decisions for Fast Subjects as a Function of Levels-Lexical Relationships: Standard Orienting Conditions

		Semantic	Phonemic	Structural
Neutral	Yes	645 (7.0)	737 (9.0)	710 (3.6)
	No	594 (0.6)	679 (0.5)	644 (0.5)
	X̄	621 (3.8)	708 (4.8)	677 (2.1)
Mean	Yes	642 (4.8)	716 (6.9)	686 (4.6)
	No	624 (2.4)	689 (2.4)	633 (0.9)
	X̄	658 (3.6)	702 (4.5)	

Note. Percent errors shown in parentheses.

Table 5

Mean Latencies in Milliseconds for Correct Responses for Lexical Decisions for Slow Subjects for Levels-Lexical Relationships: Standard Orienting Conditions

Relationship	Decision Type	Level		
		Semantic	Phonetic	Structural
Associative	Yes	821 (2.1)	765 (2.6)	675 (3.1)
	No	800 (0.0)	741 (0.6)	666 (0.0)
	$\overline{X}$	811 (1.1)	753 (1.6)	671 (1.5)
Rhyme	Yes	814 (3.6)	712 (2.1)	649 (1.5)
	No	793 (2.2)	804 (1.6)	680 (0.5)
	$\overline{X}$	804 (2.9)	768 (1.8)	665 (1.0)
Physical	Yes	788 (1.0)	785 (3.5)	673 (2.1)
	No	798 (1.5)	802 (3.2)	676 (0.5)
	$\overline{X}$	793 (0.8)	794 (3.3)	674 (1.3)

(continued)

Table 5 (continued)

Mean Latencies in Milliseconds for Correct Responses for Lexical Decisions for Slow Subjects for Levels-Lexical Relationships: Standard Orienting Conditions

		Semantic	Phonemic	Structural
Neutral	Yes	803 (5.9)	809 (3.2)	734 (3.6)
	No	763 (1.6)	737 (0.6)	651 (1.0)
	$\overline{X}$	783 (3.8)	773 (1.9)	692 (2.3)
Mean	Yes	807 (3.2)	755 (2.9)	682 (2.6)
	No	789 (1.1)	775 (1.5)	668 (0.5)
	$\overline{X}$	798 (2.1)	765 (2.2)	

Note. Percent Errors shown in parentheses.

= 7.6, *MSe* = 17517, $p < .05$. Secondly, was a significant interaction of Relationship with Decision Type (*F* (3,21) = 6.2, *MSe* = 6210, $p < .01$. This interaction reflected the fact that there was a facilitative effect of rhyming words following Phonemic *Yes* decisions, and an interference effect following Phonemic *No* decisions. There was also a trend suggesting the presence of associative priming following *Yes* decisions. Although this effect was larger in absolute terms than the associative effect for fast responders in the Semantic condition, it was not statistically reliable.

Structural Level. For the Structural condition, the fast subjects showed no significant effect; whereas, the slow subjects showed a significant interaction of Relationship by Decision Type (*F(3,21)* = 3.1, *MSe* = 5652, $p < .05$. This interaction reflected a trend for all three types of relationships to show facilitation after *Yes* decisions, but not after *No* decisions.

While some suggestive trends appeared in these analyses, the tests were admittedly liberal and the results will be discussed primarily in conjunction with other findings for which they might prove relevant. One particularly intriguing result was the apparently different effect of SOA upon the Semantic group as opposed to the Phonemic and Structural group. It was the fast responders within the Semantic group who showed priming effects and the slow responders within the two lower level groups who showed the largest effects. This suggests that the type of levels decision might interact with the way in which the lexical decision task is performed.

Correlational Analyses

Analyses of the effect of visual similarity within the rhyme relationship and analyses of the nonword data (rhyming versus standard pseudowords) showed no reliable effects pertinent to the major issue. For this reason, the more relevant correlational analyses, and the analyses of the recall and the subject expectancy data will be presented prior to the rhyme and the nonword data. However, for the interested reader those data follow in a subsequent section.

The results of the analyses of fast and slow responders on the levels task indicated that lexical decisions may not be independent of the preceding levels task. To investigate further the relationships between the different orienting tasks and the lexical task, a number of correlational analyses were performed.

The first series correlated the mean reaction times between levels and lexical decisions separately for each relationship and type of level decision. The results of these correlations are shown in Table 6. The correlations for each cell were consistently highest for the Semantic levels condition, ranging on words trials from .71 to .90. Next highest, but of considerably smaller magnitude, were the correlations for the Phonemic levels which fell in the range of .37 to .60. Least, but still consistently positive, were the correlations for the

Table 6

Correlations Between Mean Levels and Mean Lexical Decision Latencies

Relationship	Decision Type	Level		
		Semantic	Phonemic	Structural
Associative	Yes	.90	.40	.07
	No	.83	.44	.21
Rhyme	Yes	.84	.59	.10
	No	.71	.50	.35
Physical	Yes	.85	.49	.12
	No	.71	.60	.24
Neutral	Yes	.82	.37	.21
	No	.76	.47	.13

(continued)

Table 6 (continued)

Correlations Between Mean Levels and Mean Lexical Decision Latencies

Relationship	Decision Type	Level		
		Semantic	Phonemic	Structural
Standard	Yes	.83	.64	.41
Pseudoword	No	.83	.73	.24
Rhyming	Yes	.51	.57	.37
Pseudoword	No	.87	.54	.41
Overall	Yes	.91	.49	.14
Words	No	.83	.59	.27

Note. All correlations .40 significant at p .05.

Structural levels(.07 to .35).

The second set of correlations were calculated between the latencies across subjects for each levels item and the lexical item with which it was paired. Note that since the item means are computed across subjects, it is less likely that these correlations reflect individual differences than was the case for for the correlations computed with subject means. The results of the analyses are shown in Table 7. Overall, across *Yes* and *No* decisions, there is more evidence of consistent, relationships between levels and lexical items for the Semantic condition than for the other conditions. There is evidence of a relationship between levels decisions and lexical decisions which are rhyme related in the Structural condition, and for associatively related items in the Rhyme condition following levels *Yes* decisions in the Phonemic group.

Overall, the pattern is relatively consistent, and some tentative conclusions can be drawn. The Semantic condition showed a large positive correlation between levels and lexical tasks when summed across subjects. This is consistent with (a) a general facilitative or interference effect between the two tasks, and/or (b) the subject's proficiency at one task being related to their profficiency on the other. The small, but consistent, positive, correlations for the Semantic group for items summed over subjects, however, is more congruent with an interference or facilitative effect between the levels task and

Table 7

Correlations Between Mean Item Latencies

Relationship	Decision Type	Level		
		Semantic	Phonemic	Structural
Associative	Yes	.29	.39*	.16
	No	.28	.10	-.06
Rhyme	Yes	-.10	.18	.34*
	No	.25	-.09	.41*
Physical	Yes	.27	.04	.13
	No	.25	-.26	.06
Neutral	Yes	.07	.07	.01
	No	.32	-.01	.06

(continued)

Table 7 (continued)

Correlations Between Mean Item Latencies

Relationship	Decision Type	Level		
		Semantic	Phonemic	Structural
Pseudoword	Yes	.17	.02	.02
	No	.00	.06	.10
Overall	Yes	.18*	.04	.05
Word	No	.24*	-.10	.14

Note. All correlations marked with * significant at p .05.

the lexical task. Since the means for items are calculated by summing across both fast and slow subjects, these correlations are inconsistent with an explanation that depends strictly on subjects who are fast at the levels task being fast at the lexical task, although they do not eliminate this explanation as a contributer to the correlations across subjects.

It should be noted that the Semantic group which showed the highest correlations between levels and lexical tasks also showed the largest effect of Order upon lexical decision latency. Together, these two findings are suggestive that the levels and lexical decision processes do interact. Furthermore, it is in the semantic condition where there is the least evidence of any priming effects. Perhaps the interaction of the levels and the lexical tasks tends to suppress the processes underlying priming. The suggestion that the levels and lexical tasks interact, finds further support in the results of the analysis of the fast and slow subjects. In the Semantic group, it was the fast subjects who showed the greatest evidence of priming effects, whereas in the Phonemic and Structural groups, it was the slow subjects who showed the evidence of priming.

Recall and Subject Awareness

Recall of Level Items The percent correct for recall of levels items is shown in Table 8 (a). The results for the two control conditions for the levels recall was straightforward. In both the Prime Alone and Double Prime conditions, there was a

Table 8 a

Percent Correct Recall For Levels Items

Level	Relationship					
	Associative	Rhyme	Physical	Neutral	Pseudoword	$\overline{X}$
Semantic	20.3	14.5	17.2	15.4	12.9	16.1
Phonemic	5.1	0.9	1.6	1.1	1.5	2.0
Structural	9.4	2.2	6.7	4.0	2.2	4.9
Double Prime	9.7	4.9	4.4	2.0	3.1	4.8
Prime Alone	16.5	7.4	9.2	8.3	4.2	9.1
$\overline{X}$	12.1	5.9	7.7	6.2	4.8	

main effect of relationship, *F* (4,60) = 5.6, *MSe* = 22.0, *p* < .01, and *F* (4,56) = 5.6, *MSe* = 28.1, *p* < .01, respectively. In both cases recall was higher for associate primes than for any of the other prime types.

For recall in the Standard Levels Conditions, both the main effects of Levels, *F* = 70.5, *MSe* = 62.4, *p* < .01, and of Relationship, *F* = 12.2, *MSe* = 24.2, *p* < .01, were significant. *Post hoc* comparisons showed that the main effect of Levels was due to recall being higher for the Semantic level than for the other two levels. This only partly replicates the usual Levels recall results, where there is often a reliable ordering of Semantic, Phonemic, then Structural. The main effect of relationship was due to recall being higher for the associates than for the other four conditions combined.

Recall of Lexical Items The percent recall data for the lexical items are presented in Table 8(b). The analyse of these data showed no significant differences in the Lexical Alone condition. Apparently, the control of stimulus materials equated for ease of recall. In the Prime Alone control, there was a significant effect of Relationship, *F* (4,60) = 8.3, *MSe* = 48.2, *p* < .01. Associates were recalled better than all other items. In the Double Prime condition, both associates and rhymes were recalled better than the other items, *F* (4,56) = 8.2, *MSe* = 31.3, *p* < .01.

C

Table 8 b

Percent Correct Recall for Lexical Items

Level	Relationship					
	Associative	Rhyme	Physical	Neutral	Pseudoword	$\bar{X}$
Semantic	11.4	3.1	1.8	1.8	1.0	3.8
Phonemic	4.5	1.1	1.3	0.9	0.8	1.7
Structural	8.3	4.5	3.3	3.3	1.5	4.2
Double Prime	11.5	8.7	4.4	3.5	1.3	5.9
Prime Alone	17.0	8.7	6.7	7.4	3.6	8.7
Lexical Alone	6.0	5.8	2.9	5.4	5.4	5.1
$\bar{X}$	9.7	5.3	3.3	3.7	2.3	

For the recall in the three standard levels conditions, the pattern was quite simple. There was a main effect of levels, $F(2,45) = 5.3$, $MSe = 26.7$, $p < .01$ and recall was higher for the Structural and the Semantic orienting tasks than for the Rhyme task. It is noteworthy that the most consistent priming effects occurred in the Structural group, where recall was also high.

The main effect of Relationship was also significant, $F(4,60) = 35.5$, $MSe = 10.3$, $p < .01$. More associates were recalled than any other item types, but Relationship interacted with level such that the effect was largest for the Semantic condition in both the absolute sense and in terms of proportion recalled within a group.

Subjects' Awareness of Relationships The most pertinent data from the awareness reports relating to self-terminating processing are the reports of awareness of associative relationships between the levels and the lexical words. For the Prime Alone and Double Prime conditions, all subjects were aware of the associative relationships between items. The estimated percentage of trials on which this type of relationship occurred was 24.7 percent for the Double Prime condition and 27.0 percent for the Prime Alone condition. The actual value was 16.7 percent.

For the three standard orienting conditions the estimates were 36.8 for the Semantic condition, 27.0 for the Phonemic condition, and 25.8 percent for the Structural condition. There

Table 9

Subjects Self Reports of Awareness of Relationships

Level	Relationship		
	Associative	Rhyme	Physical
Semantic	16 (36.8)	4 (27.0)	3 (16.7)
Phonemic	15 (27.0)	6 (36.8)	1 (30.0)
Structural	16 (25.8)	4 (30.0)	4 (25.0)
Double Prime	15 (25.7)	7 (29.7)	2 (5.0)
Prime Alone	16 (27.0)	10 (31.6)	1 (14.0)

Note: Subjects estimates of percent of trails upon which a relationship occured are shown in parentheses; the actual percentage was 16.7.

were no significant differences between conditions. In both the Semantic and Structural conditions, all 16 subjects reported awareness of associative relationships. In the Phonemic condition, 15 of the 16 subjects reported being aware of associative relationships between the items.

As shown in Table 9, the number of subjects reporting awareness of the rhyme and physical relationships was low in relation to those reporting awareness of the associative relationship. Unfortunately, there is a rather trivial explanation for this effect. Perhaps, most subjects did not consider rhyme and physical similarity as relationships. In light of this ambiguity in interpretation, only the data relating to the awareness of the associative relationship will be pursued.

Rhyme Relationship Trials

These analyses were carried out primarily to determine if there was any evidence that visually similar versus visually different rhyming words led to qualitatively or quantitatively different responding, especially in relation to the obtained priming effects. In the Lexical Alone condition, there was evidence that the visually similar items were responded to more rapidly than were items in the visually dissimilar condition. However, consistent with Tanenhaus et al. (1980), there was no evidence of any differential effects in the conditions where priming occurred. If anything, the results suggest that priming may have been greater for the visually dissimilar rhyme relationship pairs. The more detailed analyses follow.

The analyses for the Control Groups were 2 (Order) by 2 (Visual Similarity) by 2 (Decision Type) repeated measures ANOVA's. The analysis of the data for the three standard orienting groups included level (Semantic, Phonemic, Structural) as a between subjects factor.

Control Groups: Lexical Decisions on Rhyme Relationship Trials

The data for the three control conditions appear in Table 10. For the Lexical Alone condition, there were no significant differences, although the difference between visually dissimilar and visually similar rhymes approached significance, *F* (1,15), *MSe* = 1749, p = .06. Overall, the latencies for visually dissimilar rhyme relationship words were 15 msec longer than the latencies for the visually similar rhyme relationship words. This difference was not considered critical in that it was relatively small and it was not confounded with any interaction of rhyme type with levels in previous analyses.

The analyses of the Prime Alone condition showed three significant effects. Once more the effect of Order was significant, *F* (1,15) = 10.9, *MSe* = 7375, $p < .01$ (second presentation = 565 msec; first presentation = 616 msec). Before discussing the other two reliable effects, it should be noted again that in the Prime Alone condition, Decision Type was a pseudofactor. The subjects were not presented any questions and, therefore, made no decisions about the primes. However, each

Table 10

Mean Latencies in Milliseconds for Correct Word Decisions as a Function of Rhyme Relationship Type in the Control Conditions

Relationship	Decision Type	Level		
		Lexical Alone	Prime Alone	Double Prime
Visually Dissimilar	Yes	606 (2.2)	591 (2.1)	611 (4.5)
	No	637 (2.1)	593 (2.7)	602 (3.7)
	$\overline{X}$	621 (2.1)	592 (2.4)	606 (4.1)
Visually	Yes	602 (2.1)	594 (5.7)	628 (3.1)
	No	610 (1.4)	583 (3.0)	601 (2.7)
	$\overline{X}$	606 (1.7)	589 (4.4)	615 (2.9)
Grand Mean	Yes	604 (2.2)	593 (3.9)	619 (4.0
	No	623 (1.7)	588 (2.8)	602 (3.2
	$\overline{X}$	614 (1.9)	591 (3.4)	

Note. Percent errors shown in parentheses.

prime was presented twice, once corresponding to a *Yes* decision trial, and once to a *No* decision trial for the Standard Orienting conditions. The interaction of Order by Decision Type by Rhyme Type was significant, *F* (1,15) = 7.1, *MSe* = 1679, *p* < .05. The form of this interaction was a crossover, such that on first presentation, visually dissimilar rhymes were faster than visually similar rhymes following *Yes* decisions, and the reversal occurred on No decisions. This pattern was completely the opposite on second presentations. Any possible interpretation of this interaction is clouded by the fact that Decision Type was a pseudofactor in the Prime Alone group.

For the Double Prime condition, the analysis of the latency data yielded two effects. The first was the ubiquitous finding that latencies were shorter for second presentation of the items than for the first presentation, *F* (1,14) = 8.6, *MSe* = 5884, *p* < .01 (590 msec vs. 631 msec). The second effect of Decision Type, *F* (1,14) = 6.6, *MSe* = 1435, *p* < .05 was unexpected. Overall, subjects were faster in making decisions for the lexical items following the presentation of a category name and a levels word from a unrelated category than following a category name and a levels word from that category. A trend in the same direction was present in the previously described analysis of the Double Prime condition for all types of levels-lexical relationships. There is an interesting parallel to the standard orienting conditions, where again, lexical decisions were slower after levels *Yes* decisions. It appears that subjects in the Double Prime condition tended to make levels decisions to the category questions, despite the fact they were not required to do so. Overall, the analyses of the three control conditions yielded no significant effects which could obviate interpretations of the combined rhyme relationship items in other analyses.

Standard Orienting Groups: Levels Decisions On Rhyme Relationship Trials

As with the overall analysis, it is requisite for analyses of the lexical data to determine whether there are differences in the preceding levels conditions that may affect the lexical latencies or errors. A 3 (Levels) by 2 (Order) by 2 (Rhyme Type) by 2 (Decision Type) analyses of variance with all other factors nested within levels were performed on the latency and the error rate data which appear in Table 11.

For the latency analyses there were only two significant effects, Order, $F\ (1,45) = 17.9$, $MSe = 22939$, $p < .01$, and Decision Type, $F\ (1,45) = 43.6$, $MSe = 20945$, $p < .01$. Latencies were shorter on the second presentation of items than on the first presentations (756 msec vs. 819 msec).

Standard Orienting Groups: Lexical Decisions on Rhyme Relationship Trials

The analyses of the three standard levels data shown in Table 12 produced a number of statistically reliable effects. Again, there was the standard effect of presentation order, *F*

Table 11

Mean Latencies in Milliseconds for Correct Levels Decisions Preceding the Two Types of Rhyme Relationships

Relationship	Decision Type	Level			
		Semantic	Phonemic	Structural	Mean
Visually Dissimilar	Yes	778 (2.6)	726 (3.4)	722 (5.1)	742 (3.6)
	No	866 (9.0)	820 (4.6)	856 (5.8)	847 (6.5)
	$\overline{X}$	822 (5.8)	773 (4.0)	789 (5.4)	745 (5.1)
Visually Similar	Yes	749 (3.5)	732 (4.4)	742 (3.5)	741 (3.8)
	No	843 (5.4)	824 (4.5)	824 (4.2)	831 (4.7)
	$\overline{X}$	796 (4.5)	778 (4.5)	783 (3.8)	786 (4.3)
Mean	Yes	764 (3.0)	729 (3.9)	732 (4.3)	741 (3.7)
	No	855 (7.2)	822 (4.6)	840 (5.0)	839 (5.6)
	$\overline{X}$	809 (5.1)	775 (4.2)	786 (4.6)	

Note. Percent errors shown in parentheses.

Table 12

Mean Latencies in Milliseconds for Correct Word Decisions as a Function of Rhyme Relationship Type in the Standard Orienting Conditions

Relationship	Decision Type	Level			
		Semantic	Phonemic	Structural	Mean
Visually Dissimilar	Yes	745 (2.7)	697 (2.2)	651 (1.8)	697 (2.2)
	No	701 (3.1)	761 (3.7)	677 (1.5)	713 (2.8)
	$\overline{X}$	723 (2.9)	729 (3.0)	664 (1.6)	705 (2.5)
Visually Similar	Yes	728 (5.3)	691 (3.0)	675 (5.5)	698 (4.6)
	No	710 (3.2)	746 (2.7)	657 (0.9)	705 (2.3)
	$\overline{X}$	718 (4.2)	719 (2.9)	666 (3.2)	701 (3.4)
Mean	Yes	736 (4.0)	694 (2.6)	663 (3.6)	698 (3.4)
	No	705 (3.2)	754 (3.3)	667 (1.2)	709 (2.5)
	$\overline{X}$	721 (3.6)	724 (2.9)	665 (2.4)	

Note. Percent errors shown in parentheses.

(1,45) = 69.1, MSe = 8860, $p < .01$, with second presentation (663 msec) being faster than first presentations (742 msec). There was also a significant interaction of levels with decision type, F (2,45) = 5.2, MSe = 12811, $p < .01$. Lexical decisions were significantly shorter following *Yes* decisions than following No decisions in the Phonemic condition, but the reverse was true for the Semantic condition with the pattern for the Structural condition falling somewhere in between. This interaction is a component of the rhyme priming effect found in the overall analyses of the four levels-lexical relationships.

The four-way interaction of level with Decision Type with Order and Rhyme Type also reached statistical reliability, F (2,45) = 3.6, MSe = 5671, $p < .05$. Fortunately, the form of this interaction was relatively straightforward. Basically it can be described as a three-way interaction of Order by Rhyme Type by Decision Type which occurred for the Phonemic condition and in no other condition.

The nature of this interaction was such that on first presentations, visually similar rhyme relationship words had faster *Yes* responses, but slower *No* responses, than visually dissimilar rhyme relationship words. In terms of the overall analyses reported earlier, this means that on first presentations visually similar rhyme relationship words contributed more to the rhyme priming effect than did visually dissimilar rhymes. Exactly the reverse was true on the second presentation of the items with visually dissimilar rhymes producing faster *Yes* responses, and slower *No* responses, than the visually similar rhymes.

Overall, the most notable finding for the rhyme relationship condition was the fact that the results for both visually similar and dissimilar rhyme were congruent with the results of the rhyme relationship condition as a whole. That is, visually similar and visually dissimilar rhymes appeared to contribute equally to any rhyme priming effects that were obtained.

Nonword Items: Levels Decisions

As noted previously, a primary purpose of the inclusion of the rhyming pseudowords was to examine the possibility that subjects could be making word decisions solely on the basis of whether the lexical item rhymed with, or was structurally similar to, the preceding levels item. If this were the case, one would expect that rhyming pseudowords would yield longer latencies or higher error rates than the standard pseudowords. This finding should be particularly prevalent in the conditions where rhyming or physical priming effects occurred. Overall, the data did not support either of these conjectures. The more detailed analyses follow.

The analyses of variance for the control groups were repeated measures, 2 (Order) by 2 (Nonword Type) by 2 (Decision Type) ANOVA's. For the three standard orienting groups, Level (Semantic, Phonemic, Structural) was included as a between subjects factor.

Control Groups: Lexical Decisions on Nonword Trials

The concern of these analyses was to determine if there were significant differences between the rhyming and standard pseudowords in any of the control conditions. The analysis of the latency data for the nonword trials for the Lexical Alone, Prime Alone and Double Prime data which are shown in Table 13, revealed only one significant effect, order of presentation, F (1,15) = 14.8, *MSe* = 4998, $p < .01$ (for Lexical Alone), F (1,15) = 19.7, *MSe* = 6111, $p < .01$ (for Prime Alone), and F (1,14) = 12.0, *MSe* = 5130, $p < .01$ (for Double Prime). The means for first versus second presentation were 787 msec vs. 739 msec, 763 msec vs. 701 msec, 772 msec vs. 726 msec. Overall, the analyses of the control conditions yielded no evidence of any interesting effects, nor effects that might be confounded with effects occurring in the standard levels.

Standard Orienting Groups: Levels Decisions On Nonword Trials

Again, the data for levels decisions were analyzed first in order to determine if there were any effects which might affect the interpretation of the results for the lexical decisions. The data for this analysis appear in Table 14. For the latency data, two effects showed statistical reliability. First, there was a reliable order effect, F (1,45) = 24.3, *MSe* = 16978, $p < .01$, with responses on the second presentations of items being significantly faster than on the first presentations (753 msec

Table 13

Mean Latencies in Milliseconds for Correct Nonword Decisions as a Function of Levels-Lexical Relationship in the Control Condition

Relationship	Decision Type	Level		
		Lexical Alone	Prime Alone	Double Prime
	Yes	763 (9.9)	736 (8.1)	742 (12.9)
Rhyming	No	746 (6.5)	738 (12.1)	749 (10.3)
	$\overline{X}$	755 (8.0)	737 (10.1)	745 (11.6)
	Yes	780 (8.2)	730 (8.4)	755 (7.0)
Standard	No	765 (7.9)	726 (10.7)	751 (8.0)
	$\overline{X}$	772 (8.1)	728 (9.6)	753 (7.5)
	Yes	772 (8.8)	733 (8.3)	748 (9.9)
Mean	No	756 (7.2)	732 (11.4)	750 (9.1)
	$\overline{X}$	764 (8.0)	732 (9.8)	749 (9.5)

Note. Percent errors show in parentheses.

Table 14

Mean Latencies in Milliseconds for Correct Levels Decisions Preceding Rhyming and Standard Pseudoword Trials

Relationship	Decision Type	Level			
		Semantic	Phonemic	Structural	Mean
Rhyming	Yes	754 (8.7)	687 (2.6)	718 (4.1)	720 (5.1)
	No	854 (2.7)	810 (4.2)	824 (3.6)	831 (3.5)
	$\overline{X}$	804 (5.7)	748 (3.4)	771 (3.8)	775 (4.3)
Standard	Yes	757 (5.0)	736 (2.3)	714 (3.4)	731 (3.6)
	No	899 (9.9)	841 (3.9)	832 (3.3)	857 (5.7)
	$\overline{X}$	828 (7.4)	788 (3.1)	773 (3.4)	746 (4.6)
Mean	Yes	756 (6.8)	711 (2.4)	716 (3.8)	728 (4.3)
	No	879 (6.3)	825 (4.0)	828 (3.4)	844 (4.6)
	$\overline{X}$	817 (6.6)	768 (3.2)	772 (3.6)	

Note. Percent errors shown in parentheses.

vs. 819 msec). There was also a significant effect of Decision Type, F (1,45) = 81.1, MSe = 16029, $p < .01$. *Yes* responses were faster than *No* responses.

Standard Orienting Groups: Lexical Decisions on Nonword Trials

The latency data and error rate data for the standard orienting conditions are in Table 15. The analysis of the latency data for the standard orienting conditions showed the usual effect of faster responding on the second presentation of the items (790 msec vs. 813 msec), F (1,45) = 46.6, MSe = 12576, $p < .01$. Also significant was the effect of Decision Type, F (1,45) = 18.1, MSe = 7640, $p < .01$. Nonword decisions were slower following Levels *No* Decisions than following Levels *Yes* decisions. This is the opposite effect of that found for word trials. On word trials, responses were faster following Levels *No* decisions.

The reliable effect of most concern was the interaction of Decision Type with Nonword Type, F (1,45) = 7.5, MSe = 3654, $p < .01$. Latencies for standard pseudowords are significantly longer following *No* decisions than *Yes* decisions. This effect was significantly larger than a trend in the same direction for rhyming nonwords. Again, the reason for this is not immediately apparent.

Overall, the failure to find differences between standard and rhyming pseudowords is counterevidence to any argument that the rhyme and structural priming effects on word trials are

Table 15

Mean Latencies in Milliseconds for Correct Nonword Decisions as a Function of Levels-Lexical Relationship in the Standard Orienting Conditions.

Relationship	Decision Type	Level			
		Semantic	Phonemic	Structural	Mean
	Yes	838 (4.3)	848 (6.5)	777 (9.1)	821 (6.7)
Rhyming	No	868 (9.0)	883 (8.3)	789 (8.3)	847 (8.5)
	$\overline{X}$	853 (6.6)	865 (7.4)	783 (8.7)	834 (7.6)
	Yes	807 (6.3)	822 (6.1)	758 (4.7)	795 (5.7)
Standard	No	887 (9.1)	874 (9.6)	802 (9.0)	854 (9.3)
	$\overline{X}$	847 (7.7)	848 (7.9)	780 (6.9)	825 (7.5)
	Yes	822 (5.3)	835 (6.3)	768 (6.9)	808 (6.2)
Mean	No	878 (9.0)	878 (9.0)	796 (8.7)	851 (8.8)
	$\overline{X}$	850 (7.1)	857 (7.6)	782 (7.8)	

Note. Percent errors shown in parentheses.

simply due to a bias to classify rhyming or structurally similar items as words.

Discussion

Within the levels of processing framework, it was assumed that verbal stimuli can be encoded at three distinct processing levels. For each level, processing leads to output codes qualitatively different from those produced by other levels. The present study was an empirical investigation of the inter-level processing dynamics. An experiment was designed to determine whether processing was self-terminating or exhaustive. That is, does processing cease when the desired output code is available, or, once initiated, does processing continue until completed at all three levels? The paradigm chosen to investigate this issue was a combination of the levels of processing paradigm (Jenkins and Hyde, 1971; Craik and Lockhart, 1972) and the priming paradigm of Meyer and Schvaneveldt (1971). Four types of prime-target relationships were varied orthogonally with the type of levels task. The effect of performing the various levels tasks upon the degree to which the levels words prime subsequently presented items allowed an assessment of the way in which the levels-words are encoded.

In the introduction, a number of assumptions were made concerning processing of levels and lexical items. One assumption of the present procedure was that the levels and lexical tasks would not interact, other than for the passive spread of activation between the related items. A number of aspects of the data indicate that the two tasks interact in more complex ways. In this section, evidence for these interactions will be discussed briefly, where pertinent, to the issue of self-terminating versus exhaustive processing. Other implications of such interactions will be discussed fully in a subsequent section.

The most prominent finding relevant to the issue of self-terminating versus exhaustive processing in the results was the suppression of associative priming in the semantic orienting task. An assumption central to the present methodology for testing self-termination at lower levels, is that semantic access is both necessary and sufficient for associative priming. While it may be necessary, it evidently is not sufficient. *Post hoc* comparisons of the size of associative effects in the Prime Alone and Double Prime with the Semantic condition support the contention that associative priming is suppressed in the Semantic Levels condition. An alternative explanation of the lack of associative priming is that not all types of semantic access support associative priming. In either case, one should not infer that the lack of associative effects in non-semantic conditions indicate that processing is self-terminating.

This finding has important implications for the conclusions of previous reports. Both Smith (1979) and Tor (1979) conclude that a lack of associative priming following low level tasks indicates that processing is terminated at these lower levels. Yet neither of these studies demonstrated associate priming in a semantic orienting condition. Without such a demonstration, this conclusion cannot be accepted.

The latency data also give no strong evidence of associative priming at the Phonetic or Structural levels, although there was some indication of associative effects. Twelve of 16 subjects in the Structural condition contributed to a trend towards associative priming following structural levels *Yes* decisions. This trend was even more pronounced for the 8 subjects who were slowest on the structural levels task. Furthermore,there was a significant positive correlation between levels and lexical items following Phonemic *Yes* decisions. Nevertheless, one must conclude there was no overwhelming evidence in the lexical decision data for semantic processing during encoding with lower level orienting questions.

Despite the lack of strong evidence for exhaustive processing, the suppression of associative priming following the Semantic task precludes the conclusion that processing is self-terminating. Semantic encoding could occur in the lower level orienting groups, but as in the semantic condition, associative priming may be suppressed. Thus, as discussed previously, the lack of a Semantic condition in Smith's (1979) study and the lack of priming effects in the semantic orienting condition in Tor's (1979) study mean neither study can be readily interpreted in regard to the current issue.

Parkin's (1979) finding that a semantic orienting task led to more interference for associatively primed Stroop items than did a non-semantic orienting task appears more relevant to the interpretation of the present results. Parkin interpreted his results as indicating that the associative prime facilitated the encoding of the Stroop items in the Semantic orienting condition but not in the Non-semantic condition. His interpretation is consistent with the view that processing is terminated at a low level in that condition.

The fact that Parkin found apparent associative facilitation in the Semantic condition is in conflict with the present findings. There are a number of methodological differences between Parkin's experiment and the present study, such as the use of the Stroop task, as opposed to a lexical decision task to assess priming effects. This difference makes it difficult to determine factors underlying the differences in the results. The most basic difference is the 500 msec ISI used in the present experiment compared to the 100 msec ISI used by Parkin. Perhaps, in the present study, the levels task processing interferes with the lexical task processing, hence disrupting associative priming. At longer ISI's, this interruption may be avoided. However, it must be noted that the ISI chosen in the present study does provide a better test for short duration semantic activation following lower level processing tasks.

Another possibility is that processing in the Semantic tasks used by Parkin (semantic pleasantness ratings in Experiment 1 and living-nonliving semantic category decisions in Experiment 2) is qualitatively different from the more specific category decision used in this experiment. It may be something particular to certain semantic tasks, such as the category task, which produces the inter-task interactions that were apparent in the present study and may interfere with associative processes. On a similar vein, perhaps the type of semantic activation caused by a category decision does not support associative priming.

A final interpretation, that explains both Parkin's results and the suppression of associative priming in the present study, is also based on the concept of inter-task interference. It may be that the subject has trouble switching tasks. This effect might be greatest for the associated items in the Semantic condition because of the semantic relations between the prime and the target which become apparent to the subject when he processes the Stroop target item. For example, in Parkin's Experiment I, the increased interference effect (that Parkin interprets as resulting from a facilitation in encoding) might, in fact, result from the subject having a tendency to perform semantic pleasantness ratings on Stroop items associated to the prime words. In the Stroop task, interference due to such an inter-task interaction cannot be differentiated from interference caused by the prime facilitating encoding of the Stroop item. In the present study, such interference effects could mask any facilitory effects at the encoding level.

There is some indirect evidence from other research indicating that increased interference in a Stroop task does not always result from a facilitation of encoding but instead may result from a more general interference process. Whereas both rhyme and physical primes produce interference in a Stroop task (Tanenhaus et al., 1980), in a lexical decision task, rhyme primes produce facilitation and physical primes may produce interference (Meyer et al., 1975; Shulman et al., 1978). The effect of rhyme primes can be easily interpreted in both tasks as being due to facilitation of encoding. Conversely, the most parsimonious interpretation of the physical priming effects is some sort of more general interference which occurs in both tasks.

The present findings also have implications for the interpretation of other research related to the issue of exhaustive versus self-terminating processing. Assume, as suggested by the present results, that associative priming is suppressed by certain tasks obviously involving semantic access. If so, then a simple lack of associative priming in a non-semantic task cannot stand alone as support for self-terminating processing. This is true even if certain semantic tasks are found to support associative priming. The fact that semantic access is not sufficient to yield associative effects, renders the lack of associative effects uninterpretable in terms of the occurrence or nonoccurrence of semantic access. In order more fully to investigate this issue, what is needed is a better understanding of the ways in which the interaction of the levels and lexical tasks might suppress associative priming, and some indication of when these interactions might be occurring.

To this point, the focus of the investigation has been on automatic semantic access, but the phonemic and structural priming effects may also shed some light upon processing dynamics. One disquieting result concerning lower level priming was the lack of physical and rhyme priming in the Prime Alone condition. This finding is at odds with the published results of Fowler et al., (1981); Hillinger (1980); Meyer et al., (1974), Shulman et al.(1978) and Tanenhaus et al.(1980), and will be discussed briefly prior to discussing physical and rhyme priming in the standard orienting groups.

The simplest explanation for the lack of a rhyme priming effect is that phonemic codes do not remain active for the 500 msec ISI. Hillinger (1980) used ISI's of 250 msec (Experiment 1) and 0 msec (Experiment 2) and produced similar priming results (46 msec at 250 msec ISI versus 38 msec at 0 msec ISI). If the ISI between the prime and target is the critical variable, the phonemic code must fade rapidly between 250 and 500 msec even though there is no evidence of it fading between 0 and 250 msec.

On the other hand, the lack of a physical effect can not be simply due to the short ISI because Fowler et al. (1981) report physical priming at an ISI of 1500 msec. This finding also suggests that ISI is not the critical factor in the rhyme priming condition since evidence indicates that physical codes are more labile than name (and presumably phonemic) codes.

An alternative interpretation, of the lack of rhyme priming in the Prime Alone condition, is that the processes supporting rhyme, and the processes supporting associative priming, are mutually exclusive. Rhyme and physical priming have been demonstrated in one experiment, as have associative and physical priming. Despite some evidence of co-occurence in the present study, definitive associative priming and rhyme priming effects have not been shown in one experiment. The inclusion of all three types of prime-target relationships may even disrupt structural priming. Despite the fact that there was no *a priori* reason to suspect that this might be the case, it is certainly an issue worth pursuing.

Unlike the control conditions, rhyme priming occurred in both the Phonemic and the Structural groups, and physical priming occurred in the Structural group. Interpretation of these facilitory effects is made difficult by evidence that they may reflect complex inter-task interactions. The two-way interaction of Decision Type by Relationship supports this concept of more complex interactions between the levels and the lexical task.

The conditions yielding the shortest lexical decision latencies following levels *Yes* decisions tend to yield the longest reaction times following levels *No* decisions. Overall, the three relationships (associate, rhyme, physical) tend to yield shorter latencies than the neutral items after *Yes* decisions and longer latencies after *No* decisions. Of course, the three-way interaction showed that in terms of individual relationships this trend reached significance only for the rhyme relationship in the Phonemic condition. Nevertheless, the pattern is relatively consistent.

One plausible explanation for the interaction of Decision Type with Relationship is that for lexical items, related to the preceding levels item on an associative, rhyme or physical dimension, the subjects tend to make the same type of decision as they did for the levels word. For example, following a Phonemic *Yes* decision, the subject would tend to make *Yes* decisions to lexical items rhyming with the preceding levels item. The presence of facilitative effects after *Yes* decisions, and interference effects after Phonemic *No* decisions, for rhyme relationships is congruent with this hypothesis. However, there is other evidence that does not meet the predictions of this explanation. From a simple version of such an interpretation of the facilitative effects, it would be predicted that whenever there are large facilitative effects for rhyme primed or physical primed word stimuli, there should be high error rates or long latencies for rhyming pseudoword stimuli. At the same time, there should be interference effects following *No* decisions. This did not occur.

In summary there was evidence of inter-task interactions beyond those that have been conceived as underlying priming effects. However, the facilitory effects that do occur are not easily explained as being artifacts of these inter-task interactions. It is more likely that these effects reflect, at least in part, the prime preactivating phonemic and structural information used in the encoding of the target item.

One indication that processing does proceed beyond the level requisite for responding to the orienting question is the occurrence of the rhyme priming effect following structural *Yes* decisions. This effect did not appear to be based solely on structural similarity. Priming effects were of equal magnitude for both visually similar and visually dissimilar rhymes in the structural task. Apparently, with the letter search task, processing occurs at both the phonemic and structural level.

An appealing interpretation of rhyme priming in the phonemic condition is that the positive low level decisions result in a focussing within lower levels, producing a relatively stronger and longer lasting lower level code than might otherwise occur. The presence of physical priming in the Structural condition is also congruent with the view that the lower level orienting tasks focus processing within that particular level, leading to a stronger or more widespread activation of information.

The recall of the levels and lexical items was not an ideal measure to assess the issue of self-terminating versus exhaustiveness during the encoding of levels items. There was an effect of associative relationship upon recall for all three levels. This is an interesting effect and is congruent with the findings of Postman et al. (1978) and Parkin (1979) that associative effects occur with low level orienting tasks. However, as noted in regard to these earlier studies, the presence of associative effects in recall data could be the result of processes occurring at retrieval instead of encoding.

Overall, the recall data replicate the common finding that recall is highest for a semantic orienting condition. A somewhat unusual finding was the lack of a difference between recall for the Phonemic and Structural conditions. However, this is consistent with the interpretation of the priming effects which suggested that phonemic encoding occurred in the letter search task. An alternative explanation is that recall was approaching floor in both these groups.

There was no difference between the levels conditions in the number of subjects reporting awareness of associative relationships, nor in their estimates of the proportion of trials upon which such relationships occurred. However, since awareness ratings followed the recall task, it cannot be ascertained whether this awareness arose during presentation of the awareness ratings, during retrieval, or during the presentation of the items. Comments from the subjects seem to indicate that awareness did occur during the presentation trials. Even then, it is possible that semantic encoding of the levels items in the non-semantic conditions did not occur until the presentation of the subsequent lexical items. In any event, the evidence in both the recall data and the awareness ratings of semantic access on non-semantic levels trials suggests the need for further investigation. Of particular interest, is the apparent independence of associative priming from associative effects in recall, and in awareness of the associative relationship. Perhaps recall and concious awareness of associative relationships, are mediated by different aspects of the information preactivated by the prime than are the priming effects on lexical decisions.

Summary of Evidence on the Issue of Exhaustive and Self-terminating Processing

The current study provided no conclusive evidence on the issue of self-termination versus exhaustiveness. In the latency data, there was some evidence of associative coding on the non-semantic trials, and much stronger evidence of phonetic coding in the structural task. Furthermore, both the recall data and the awareness data indicated that associative effects occurred in the non-semantic conditions. These latter results were difficult to interpret, as they may have arisen in processes occurring during retrieval. Overall, results did not provide definitive evidence of exhaustive processing.

The suppression of associative priming after a semantic levels task brings into question the viability of concatenating tasks in assessing the issue. One must question the validity of at least three other studies in the literature, which used methods similar to that of the present study (Smith, 1979; Tor, 1979; Parkin, 1979). All these studies showed that a non-semantic task resulted in no associative priming which suggested that processing is self-terminating. Since in the present study, a semantic levels task, requiring semantic access, did not result in associative priming, the lack of associative priming in a non-semantic task cannot be interpreted as indicating self-terminating processing.

Of course, a demonstration of exhaustive processing using concatenated tasks would be valid. However, in the present study there was evidence of one or more inter-task interactions, which may have presumably suppressed associative priming on the semantic condition. Thus, the present paradigm may not provide a sensitive test of this issue. For now it must be concluded that the question of self-terminating versus exhaustive processing is still open.

The inter-task interactions are a flagrant contradiction of basic assumptions made by researchers using this method. As outlined in the introduction, it is generally assumed that the processes involved in each task performed individually, are the same as the processes in each task when they are concatenated. Apparently this not the case. Nevertheless, if such interactions could be operationally defined, one might be able to manipulate various parameters or change the levels orienting task so as to minimize these interactions and provide a more appropriate vehicle for testing various issues.

Aside from the central issue of self-terminating versus exhaustive processing, the present demonstration of inter-task interactions has a number of implications for cognitive and information processing research methods and theorizing. For example, despite the acknowledgement of workers in the divided attention literature that performing two tasks in a limited time period may change their underlying processes (Navon and Gopher,1980; Norman and Bobrow,1976), many researchers using this methodology ignore or pay only lip service to this possiblity. The response, if any, has been to keep the overlapping tasks exceedingly simple. This may constitute an overly specialized situation. The following section will attempt a preliminary description of interaction effects and suggest some avenues for further research. At this juncture, it should be acknowledged that both Smith (1979) and Parkin (1979), who used paradigms similar to the present one, also suggested the possibility of such interactions occurring.

Inter-task Interactions: Empirical Evidence.

Before suggesting some possible processes underlying inter-task interactions, the main evidence for inter-task interactions in this study will be reviewed. There are six major results in the present study which are consistent with inter-task interactions above and beyond the prime pre-activating information which are used in the encoding of the target item. First, there is the across-subject and across-item correlations between levels and lexical latencies. These positive correlations decreased in order of magnitude from the semantic to the structural conditions. Second, there is the finding that lexical decisions were longer for all orienting conditions than for the control conditions.[5] Third, there was the apparent suppression of associative priming following the semantic orienting condition, even though the same items produced associative priming in two control conditions. Fourth, in the lexical decision task ***Word*** decisions were faster following levels *No* decisions, and *Non-words* decisions were faster following levels *Yes* decisions. Fifth, there was a two-way interaction involving levels Decision Type and Relationship and a three-way interaction involving Levels, Levels Decision Type and Relationship. The two-way interaction indicated facilitory priming effects following Levels *Yes* decisions, and interference effects following Levels *No* decisions. The nature of the three-way interaction was such that the patterns of facilitation and interference changed across levels. The sixth result, indicating the presence of inter-task interactions, was the finding that lexical decision latencies for particular items decreased more from the first to the second presentation of that item within the Semantic group than within the other two groups.

Before proceeding, I would like to make a closer assessment of the correlation data as evidence for inter-task interactions. At face value the correlations across subjects indicate subjects who are fast on the levels decisions are fast at the lexical task. Given a certain theoretical oriention, one might say that the correlations indicate the degree to which levels tasks and lexical tasks tap the same processes. Higher correlations indicate more common processes. In this study, the highest correlations occur for the Semantic level, the next highest for the Phonemic level and the smallest for the Structural level. This suggests that the semantic orienting task and the lexical task share the most processes, the phonemic task and the lexical decision task have the next greatest number of overlapping processes, and the structural and the lexical task share the least. Such a hypothesis is certainly congruent with models that present the lexical decision process as tapping the processes involved when words access meaning (Becker, 1980; McCuster, Hillinger & Bias, 1981)

A second interpretation is that the correlations may, to some extent, reflect the degree to which the levels task interacts with the lexical task. Whether the interaction between the levels and lexical tasks responsible for the correlations is interfering or facilitating appears indeterminable at the present time. Given the increase in lexical reaction time from the control conditions to the standard orienting conditions, an interference interpretation might appear more apt. This interpretation is not necessarily inconsistent with the prior one. The presence or absence of subject correlations alone cannot clarify the issue. However, the presence of small but consistent correlations between the mean latencies for the semantic levels items and the lexical items with which they were paired suggests that for the Semantic condition there was an interaction between the levels and lexical processes.

Inter-task Interactions: Underlying Processes

There are probably innumerable ways that two tasks presented successively can interact. The present experiment was not designed specifically to investigate the processes underlying empirical inter-task interactions. Therefore, it is not possible to ascertain exactly how the tasks are interacting. However, it is possible to make some tentative suggestions based on previous research, current data and current theory. The processes suggested here are in no way intended to be mutually exclusive alternatives.

Differential Weighting of Codes Carry-over. The first suggestion assumes that semantic, phonemic, and structural information all can be useful in determining if a particular item is a word (as in Mortons (1969) logogen model word; see Shulman, 1977 for data supporting such an assumption). In the present situation subjects may be set in a certain mode of processing by the levels task. This mode may determine the weighting of the codes (semantic, phonemic and structural) used in making the lexical decisions. For example, following phonemic levels decisions subjects may be weighting the phonemic code more than they do following semantic or structural decisions.

The two results most congruent with this concept are (1) the increase in latencies from the control conditions to the standard Levels orienting conditions, and (2) the greater decrement in lexical decision latency from the first to the second presentation of an item, for the Semantic group compared to the other groups. With regard to (1), the extreme weighting of a particular code could lead to less efficient lexical decision processes. The second result is readily interpreted as the lexical decision process in the Semantic group involving a relatively greater weighting of a semantic code. Presumably, the greater semantic weighting could maintain activation to a greater degree than weighting more peripheral codes. The concept of differential weighting could be more extensively tested by varying the dimensions upon which the pseudowords resembled words across the different levels. For example, if this suggestion is correct, this model would predict that in the Phonemic group there should be high error rates to pseudowords which are pronounced identically to real words (e.g., neet).

Switching Time. The second suggestion is based on the assumption that any task requires a set of procedures to be performed and that the procedures require a certain set-up time each occasion the subject begins to perform a task (see Dixon, 1980 for a similar analysis of subjects attentional strategies). Furthermore, we must assume that only one set of procedures can be maintained in an active state at any particular time.

More specifically, the subject must assemble a set of procedures to perform the lexical decision task. The same is true for any particular levels task. The assembly of the levels task procedures results in the dismantling of the lexical task procedures. After performing the levels decision task, time must be taken to re-assemble the lexical decision procedures. A possible added assumption is that if tasks A and B share certain sub-procedures, there will be less time involved in assembling procedures for Task A following Task B, than if A followed Task C which shared no subprocedures with A. With or without this added assumption, such an interaction will be called a switching time. Generally, this type of interaction seems to be related to the concepts of concurrence cost and concurrence benefit (Navon & Gopher, 1980).

The strongest evidence for this type of inter-task interaction is the overall increase in lexical decision latencies from the control conditions to the standard orienting conditions. Presumably the switching time must be greater than 500 msec to produce increments in the overall lexical-latencies. Such an estimate is congruent with the report of Dixon (1980) that the response time resulting from the selection a particular processing strategy is in the range of 800 msec. If this explanation of the difference between latencies from the control to the standard orienting conditions is correct then one prediction is that (within limits) larger ISI's should decrease the difference between the control and the standard conditions.

One might also hypothesize that the switching of tasks is responsible for the suppression of associative priming. Meyer and Schvaeneveldt (1976) report that interposing a *Non-word* decision between the prime and target eliminates associative priming. They suggested that one possible cause of this suppression is that *Non-word* decisions reset the system. Switching tasks also could result in a resetting of the system. Alternatively, as suggested earlier in the discussion, switching time might be longer when items in the second task are associatively related to those in the first task.

Depleted Resources Carry-over. Another alternative is that after a particular processing mechanism or resource is used there is a non-zero recovery time before such a processing mechanism (or level in the current situation) functions at its most efficient rate. Performing two tasks that require the same processing mechanism very close together in time would result in a decrement in performance. This situation might be considered analogous to that in which simultaneously performed tasks share a common pool(s) of resources, a situation which generally results in performance decrements (Navon and Gopher, 1980). Presumably, the lexical decision process may require processing resources at all or any of the three levels. Very shortly after completion of a levels decision, lexical decision processing would be slowed.

Some evidence for this type of interaction comes from the correlation data. The large correlations in the Semantic group are consistent with resources being shared between the semantic and the lexical decision processes. Such overlapping resources is congruent with current theoretical models of the lexical decision process. Basically, it is assumed that lexical access is a step in accessing semantic information (Becker, 1980; McCusker et al., 1981). However, both the switching time alternative and the differential weighting of codes hypothesis given appropriate assumptions, also predict that correlations should be higher between the semantic decision and the lexical decision latencies than between the other levels decisions and the lexical latencies.

One could hypothesize that the shared resources also maintain the activation of common information that is responsible for associative priming. The depletion of such resources could thus suppress associative priming effects. Presumably, subjects who have the easiest time with the semantic questions would suffer the smallest drain on their resources. They should then have the greatest probability of showing associative priming effects. The fact that the fastest subjects in the Semantic condition showed a small but reliable effect of associative relationship is consistent with this interpretation.

Task Type Carry-over. In terms of less subtle interactions than the above, one could assume that subjects will confuse two tasks performed close together in time. For example, following the phonemic levels task subjects would attempt to perform the lexical decision task as a rhyme decision task.

This type of alternative seems the least interesting of the hypothesized inter-task interactions. In its extreme form, such a carry-over effect would lead to a very high percentage of errors and/or very long latencies on the trials on which it occurred. In the present study, the long latency responses and errors which might reflect such effects were eliminated from the major analyses. Hence, this type of carry-over has minimal relevance for the analyses of correct latencies. In a less extreme form, it seems that Task Type carry-over reduces to other types of inter-task interactions such as Switching Time.

Decision Type Carry-Over. Again, in terms of more gross interactions, having made a certain type of decision (e.g., *Yes*, that's a category member) subjects may be biased towards making the same (or perhaps the opposite) decision on the following lexical decision (e.g., *Yes*, that's a word).

The strongest empirical evidence for this type of process, is the main effect of Decision Type on both *Word* decision and non-word decision latency. The fact that *Word* decisions are fastest after levels *No* decisions and *Non-word* decisions fastest after levels *Yes* decisions suggest subjects are biased towards the decision opposite to that they have just made.

The concept of decision type carry-over with one added assumption was explored briefly earlier in this paper, in relation to the priming effects in the Phonemic and Structural conditions. Despite some supporting data, evidence contrary to its predictions was noted. It was found inadequate to explain all the priming results.

Response Type Carry-Over. At an even more peripheral level subjects may find it easier to push the same button twice in a row than to alternate (or vice versa).

Despite the fact it has implications for methodology, at face value response carry-over does not appear as theoretically relevant to cognitive psychology as the other alternatives. Also, one of the strongest pieces of evidence for response carry-over is the effect of decision type (*Yes*/No) on both word decision latencies, and non-word decision latencies. Specifically *Word* decisions were faster after levels *No* responses and *Non-word* decisions were faster after levels *Yes* decisions. However, for *Word* decisions, there was a trend for this effect to occur in the Double Prime group where no overt response to the levels item was required.

Summary of Inter-task Interactions

There is some degree of empirical support for all of the six types of inter-task interactions suggested. Empirical evidence congruent with a carry-over of Decision Type included the main effect of levels Decision Type on Lexical decision latency. The inter-subject and inter-item correlations were judged to be congruent with Depleted Resources, Switching Time, and Weighting of Codes. The overall increase in reaction time from the control conditions was considered congruent with Switching Time, change in Weighting of Code, and Depleted Resources. Finally, both the Switching Time and Depleted Resources were thought to be compatible with the suppression of associative priming. Clearly, no firm conclusions can be made on the basis of the present data, but a number of avenues for future research have been indicated which may elucidate task interactions and more generally the processing of verbal material.

Overall Summary

This study was a first attempt to flesh out a levels of processing approach to perceptual processing. The experiment was designed to determine whether inter-level processing was exhaustive or self-terminating. The prototypical levels of processing explanation of performance on memory tasks has assumed that the level at which a stimulus is processed is controlled by task demands.

The method used to conduct this investigation involved concatenating a level orienting task with a lexical decision task. The levels item was related to the lexical item in one of four ways (associative, rhyme, physical or neutral). The effect of the type of levels orienting task upon the efficacy of the levels item to act as a facilitory prime was hypothesized to provide an indicator of the level(s) at which the levels item was processed.

There was evidence in the structural orienting condition that processing was not terminated at the structural level but continued to the phonemic level. There was also some indication of associative priming in the non-semantic conditions but overall there was no strong evidence of exhaustive processing. Both the recall data and the awareness data showed associative effects in non-semantic conditions but it could not be determined whether these effects were due to processes occurring at encoding or at retrieval. Overall, it was concluded there was no strong support for an exhaustive model.

Interpretation of the lack of associative priming in the nonsemantic conditions and similar results in the literature were made difficult by the suppression of associative priming in the semantic condition. It was concluded, that if semantic access is not sufficient to produce associative priming, the lack of associative priming in non-semantic tasks cannot be interpreted as support for a self-terminating model of processing.

It was suggested that, in the semantic orienting group and perhaps in the other groups to a lesser extent, associative priming was suppressed by interactions between the levels and the lexical tasks. There were several indications of such interactions occurring. A number of processes that might underlie such interactions were outlined, along with a description of the data that were compatible with these processes.

Footnotes

[1] The levels items in the Prime Alone and Double Prime Alone were presented for 850 msec. This interval was an estimate of the mean time to complete a levels decision. It was obtained from an analysis of some pilot data.

[2] In keeping with an *a priori* decision, based on pilot data and research in the literature, all subjects who had error rates of over 12.5% to lexical *Word* decisions or 25% to lexical *Non-word* decisions were eliminated during the running of the experiment. Each of these subjects was replaced with another randomly selected subject. The total number of subjects eliminated was five, with two eliminated from the Structural Levels condition and one each from the Phonemic, Semantic and Prime Alone condition. One subject who should have been eliminated and replaced in the Double Prime condition was inadvertently not replaced. The inclusion or exclusion of this subject made absolutely no difference to the results. The data reported exludes the subject.

[3] At this juncture, it should be brought up again that there was a trend for latencies to be larger on the Phonemic Levels decisions preceding associative relationship trials than on those preceding the other relationships. It is plausible that this presumably differential difficulty upon the levels trials might lead to larger latencies on the subsequent lexical trials. (Note however

this is not the case for the main effects of level and decision type in which levels latency varies inversely with lexical latency.) The artifact could cancel out any latency differences due to associative facilitation. To get a clearer picture of the plausibility of this argument, an analysis was performed on only those subjects for whom Phonemic Levels decision latencies were shorter preceding associative relationsip than preceding the neutral items. Admittedly lacking in power, being based on only five subjects, this analysis provided absolutely no evidence of even a trend to support this hypothesis.

[4] To investigate further the possibility that the difference in levels reaction times might be masking (or causing) differences in processing speed for the lexical decision items, a separate analysis of covariance was performed for each of the three standard orienting levels. The lexical decision latency was the dependent measure, and for each Order by Decision Type by Relationship cell, the covariate measure was the corresponding levels latency. There were no change in the results for any Levels group.

[5] The means from the three control conditions were compared to the means from the three standard orienting conditions. There was an overall effect of condition, F (5,95) = 8.8, MSe = 124805, $p <$ .01, The means for the three control conditions combined were less than for the three standard orienting conditions.

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APPENDIX A

STIMULUS ITEMS LISTED BY LEVEL WITHIN A CATEGORY

SEMANTIC QUESTION		PHONEMIC QUESTION		STRUCTURAL QUESTION		LEVELS ITEM	LEXICAL ITEM
YES	NO	YES	NO	YES	NO		
1							
time	relative	stray	pain	a	e	day	night
time	metal	flower	park	u	k	hour	sour
time	animal	leek	thin	k	r	week	weep
time	colour	deer	pass	y	i	year	far
time	utensil	peon	pest	o	d	eon	farp
time	speech	cage	gain	g	c	age	dage
2							
relative	furniture	rant	song	u	k	aunt	uncle
relative	time	lease	site	i	a	niece	piece
relative	body	bother	plus	h	u	father	fat
relative	fruit	mister	fund	r	y	sister	glove
relative	weapon	fife	vast	e	o	wife	charp
relative	dwelling	fun	cell	s	g	son	retter
3							
metal	alcohol	fin	mine	i	r	tin	can
metal	crime	seal	hole	s	r	steel	meal
metal	clergy	bold	pull	d	s	gold	golf
metal	geology	stopper	edge	o	l	copper	label
metal	weather	link	quick	i	f	zinc	famp
metal	clothing	luss	motor	a	u	brass	boaf
4							
animal	building	coarse	block	r	d	horse	ride
animal	music	rig	thick	p	o	pig	fig
animal	money	cog	cross	d	i	dog	dot
animal	vehicle	pat	share	t	s	cat	city
animal	vegetable	sow	fresh	o	a	cow	pammer
animal	footwear	care	trust	b	c	bear	gouse
5							
colour	bird	clue	loan	l	o	blue	sky
colour	insect	shred	blind	d	b	red	said
colour	tree	lean	box	g	p	green	great
colour	fish	sack	luck	k	r	black	bible
colour	time	crown	eat	r	d	brown	trown
colour	relative	sink	sale	n	t	pink	stean
6							
utensil	metal	strife	fate	i	d	knife	sharp
utensil	animal	moon	host	n	l	spoon	tune
utensil	colour	pork	mood	r	n	fork	fort
utensil	body	up	dean	u	k	cup	scale
utensil	speech	fan	seal	p	g	pan	fube
utensil	furniture	fate	roll	p	n	plate	dickel
7							
speech	utensil	curd	maid	r	l	word	letter
speech	fruit	gown	disk	o	g	noun	clown
speech	weapon	herb	dull	r	p	verb	very
speech	dwelling	howl	phone	v	d	vowel	mess
speech	alcohol	mound	blind	d	k	sound	dound
speech	crime	paws	pack	d	n	clause	pake

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8							
furniture	clergy	ramp	carve	p	b	lamp	light
furniture	geology	fable	sheet	l	r	table	cable
furniture	weather	fair	pride	c	v	chair	chain
furniture	clothing	fed	bound	e	r	bed	street
furniture	building	pouch	guest	c	k	couch	bardle
furniture	music	cool	tough	l	n	stool	ged
9							
body	money	lie	grain	e	c	eye	ball
body	bird	charm	pound	a	e	arm	farm
body	vegetable	beg	shock	e	c	leg	log
body	vehicle	dead	fence	e	l	head	seat
body	footwear	hose	split	o	p	nose	tose
body	insect	land	cloud	d	l	hand	dight
10							
fruit	time	cape	scope	g	l	grape	vine
fruit	fish	teach	pride	a	d	peach	each
fruit	relative	mare	slit	a	y	pear	peak
fruit	metal	hairy	mount	y	a	cherry	game
fruit	animal	numb	cry	u	e	plum	dair
fruit	colour	climb	joy	l	a	lime	shorm
11							
weapon	tree	stun	lee	g	e	gun	shoot
weapon	speech	leer	dim	p	g	spear	ear
weapon	furniture	lord	net	d	a	sword	store
weapon	body	trifle	mad	i	a	rifle	rock
weapon	fruit	crystal	mud	l	a	pistol	tope
weapon	dwelling	stagger	scheme	g	f	dagger	trange
12							
dwelling	utensil	went	drag	t	d	tent	camp
dwelling	weapon	louse	hide	e	i	house	mouse
dwelling	alcohol	butt	urge	u	l	hut	hot
dwelling	crime	foam	cope	m	g	home	laugh
dwelling	clergy	sailor	stretch	a	g	trailer	bamp
dwelling	geology	track	trap	s	p	shack	clade
13							
alcohol	weather	din	pole	i	a	gin	tonic
alcohol	clothing	steer	lock	e	m	beer	fear
alcohol	building	fine	soap	e	s	wine	wind
alcohol	music	hum	rang	r	t	rum	food
alcohol	money	frisky	rush	y	u	whiskey	trisky
alcohol	bird	handy	bell	n	e	brandy	meach
14							
crime	vegetable	parson	beam	r	y	arson	fire
crime	vehicle	reason	grab	t	i	treason	reason
crime	footwear	cape	dive	a	n	rape	rope
crime	insect	left	mode	e	a	theft	girl
crime	tree	fault	grip	s	e	assault	tepper
crime	fish	herder	fame	m	n	murder	doot

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15							
clergy	time	least	neap	i	m	priest	church
clergy	relative	ton	dump	u	r	nun	sun
clergy	metal	master	rail	r	e	pastor	past
clergy	animal	hope	quit	p	t	pope	dish
clergy	colour	liar	rope	r	s	friar	moil
clergy	utensil	punk	swim	n	a	monk	pide
16							
geology	speech	ache	debt	k	i	lake	water
geology	furniture	plea	curb	a	n	sea	fee
geology	body	pill	lend	i	r	hill	hall
geology	fruit	tally	fond	v	p	valley	hoop
geology	weapon	whiff	grin	c	r	cliff	bish
geology	dwelling	grave	earl	v	n	cave	drave
17							
weather	alcohol	sew	dose	s	a	snow	white
weather	crime	bale	gaze	a	v	hail	trail
weather	clergy	sane	trot	n	k	rain	raid
weather	clothing	neat	limp	l	c	sleet	pull
weather	building	cog	snap	g	v	fog	mog
weather	music	form	sigh	s	c	storm	clow
18							
clothing	geology	flirt	pray	s	n	shirt	tie
clothing	weather	rants	pose	s	l	pants	dance
clothing	money	moat	duke	a	s	coat	cost
clothing	bird	flirt	zone	i	a	skirt	punch
clothing	vegetable	better	rake	w	g	sweater	norch
clothing	vehicle	mat	warn	a	s	hat	lod
19							
building	footwear	hoof	wipe	o	i	roof	top
building	insect	fall	hunt	a	s	wall	doll
building	tree	flare	halt	s	w	stair	star
building	fish	bore	bite	r	a	door	milk
building	time	zoom	heel	r	a	room	naid
building	relative	gore	vain	o	s	floor	thoor
20							
music	metal	torn	moss	n	a	horn	blow
music	animal	dumb	couch	u	s	drum	come
music	colour	cute	cream	t	r	flute	flour
music	utensil	crumpet	bread	p	o	trumpet	cut
music	speech	middle	wept	e	p	fiddle	dunch
music	furniture	tarp	seam	p	e	harp	fow
21							
money	body	collar	liver	I	e	dollar	bill
money	fruit	fickle	nurse	l	p	nickel	pickle
money	weapon	mime	candy	d	n	dime	dirt
money	dwelling	many	dairy	n	u	penny	tiger
money	alcohol	loin	sweat	c	t	coin	mout
money	crime	pent	flame	n	p	cent	bine

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22							
bird	clergy	foul	twist	o	e	owl	hoot
bird	geology	regal	blast	g	n	eagle	beagle
bird	weather	bobbin	chart	i	l	robin	robe
bird	clothing	marrow	steam	w	l	sparrow	town
bird	building	ten	tumor	n	d	wren	chot
bird	music	talk	boost	w	n	hawk	bawk
23							
vegetable	money	free	brace	a	g	pea	pod
vegetable	bird	neat	cease	e	w	beet	fleet
vegetable	vehicle	born	crude	c	i	corn	core
vegetable	footwear	keen	chill	e	o	bean	glide
vegetable	insect	bunion	purse	n	w	onion	meagle
vegetable	fish	parrot	prone	c	n	carrot	sarrot
24							
vehicle	vegetable	tuck	moist	k	e	truck	driver
vehicle	tree	note	ghost	b	c	boat	vote
vehicle	time	fuss	blond	s	a	bus	but
vehicle	relative	par	crest	a	e	car	boy
vehicle	metal	slip	slice	i	n	ship	cleet
vehicle	animal	like	patch	k	c	bike	fike
25							
footwear	colour	mate	bleak	a	i	skate	blade
footwear	utensil	candle	flock	s	k	sandal	handle
footwear	speech	you	merge	h	i	shoe	shot
footwear	furniture	root	roast	o	s	boot	scene
footwear	body	flipper	swear	e	k	slipper	neft
footwear	fruit	dock	blunt	k	b	sock	dase
26							
insect	weapon	cider	clock	s	t	spider	web
insect	dwelling	plea	dread	a	o	flea	ski
insect	alcohol	mat	dense	n	c	gnat	goal
insect	crime	slant	pearl	a	k	ant	save
insect	clergy	me	quack	b	a	bee	spee
insect	geology	cloth	thigh	o	s	moth	naze
27							
tree	weather	search	wheat	r	o	birch	bark
tree	clothing	dine	ham	i	b	pine	line
tree	building	folk	map	a	s	oak	oar
tree	music	loose	tap	e	a	spruce	make
tree	money	staple	rag	m	o	maple	shorm
tree	fish	helm	shy	l	a	elm	felm
28							
fish	bird	lark	cab	k	l	shark	jaws
fish	vegetable	lout	nod	r	i	trout	doubt
fish	vehicle	like	spy	e	r	pike	pick
fish	footwear	rod	ash	c	e	cod	grass
fish	insect	luna	string	u	o	tuna	pode
fish	tree	lurch	thread	e	m	perch	ferch

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APPENDIX B

PROGRAM FOR DISPLAYING STIMULI

```
0: wti 0,2;wti 4,9;wti 4,8
1: drive 0
2: dsp "PRIMING BY PROCESSING LEVELS";stp
3: dim A$[11].B$[7],C$[7],J$[16],R[28],S$[50]
4: dim T[28,12],F[2],V[28,12],Z[10,2]
5: dim O[336,3],K$[6],F$[3],L$[5],Q[48.3]
6: ent "Levels Only (1)",P;if P=1;sfg 7;gto +4
7: ent "Lexical Only (1)",P;if P=1;sfg 6;gto +3
8: ent "Prime Only (1)",P;if P=1;sfg 14
9: ent "Double prime? enter 1",P;if P=1;sfg 9
10: ent "SEMANTIC(1):RHYME(2):STRUCT(3)",Z
11: if Z=1;sfg 1;1}r1;10}r2;11}r3;20}r4
12: if Z=2;sfg 2:21}r1;27}r2;28}r3;34}r4
13: if Z=3;sfg 3;35}r1;35}r2;36}r3;36}r4
14: wtb 706,27,40.65
15: wtb 706.27,38,100,68;wtb 706,27,38,107,49,93
16: wrt 706,"                                                    "
17: wrt 706,"        PRIMING BY PROCESSING LEVEL       "
18: if flg7;wrt 706,"                  LEVELS TASK ONLY  "
19: if flg6;wrt 706,"                  LEXICAL TASK ONLY "
20: if flg14;wrt 706,"                  PRIME TASK ONLY"
21: if flg9;wrt 706,"              Double Prime Task Only "
22: wtb 706,27,38,100,65;wtb 706,10
23: if flg1;wrt 706,"***SEMANTIC (LEVELS) DECISION***"
24: if flg2:wrt 706,"***RHYME (LEVELS) DECISION***"
25: if flg3;wrt 706,"***STRUCTURE (LEVELS)DECISION***"
26: wtb 706,27,38,107,48,83
27: "   lex"}K$
28: "   lev"}J$
29: ent "Subject number",F$;F$}J$[1,3]}K$[1,3]
30: ent "new file? enter 1".r11
31: wrt 706,F$
32: if r11#1;gto +5
33: drive 1
34: open K$,12
35: if not flg6 and not flg9 and not flg14;open J$,12
36: drive 0
37: "fle"}L$[1,3];F$[2.3]}L$[4,5]
38: "Delay":int((400-2.703)/.9282865)}r10
39: "Quest":int((500-2.703)/.9282865)}r11
40: "Q-LDelay":(500-2.703)/.9282865}r12
41: "Lev-Lex":(125-2.703)/.9282865}r13
42: "Prime":if flg14 or flg9;(850-2.703)/.3282965}r12
43: wtb 718.3,20,13,10,"em::en::en::sn::sx::bm::"
44: wrt 9,"A U2=I2 U2G"
45: oni 2,"I2"
46: files WORDS,FsuRhy.*,*,*,pract,Pract
47: asgn L$,3
48: rread 3,1;sread 3,O[*]
49: rread 6,1;sread 6,Q[*]
50: sfg 5
51: "J":for I=1 to 28;for J=1 to 12;0}T[I,J]}V[I,J];next J;next I
52: drive 1
53: wrt 718,"f10.::nf4.:pe0,::pa540,520;"
```

POOR PRINT
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```
54: wrt 718,"pe1,:pa540,520;"
55: wrt 718,"::sn::"
56: wrt 718,"nf5,::pe0,::pa230,420;"
57: wrt 718,"pe1,::pa280,620;820,620;820,420;280,420;"
58: wrt 718,"::sn::"
59: for H=1 to 336
60: if r20=40;ent "check for errors",r20
61: if flg5;r20+1}r20
62: O[H,1]}Y
63: O[H,2]}X
64: O[H,3]}Z
65: if flg5;Q[H,1]}Y
66: if flg5;Q[H,2]}X
67: if flg5;G[H,3]}Z
68: (X-1)*6+Y}P
69: if not flg5;rread 1,P
70: if flg5;rread 7,P
71: on end 1,"D"
72: if not flg5;sread 1,S$
73: if flg5;sread 7,S$
74: "D":if Z=1;S$[r1,r2]}A$
75: if Z=2;S$[r3,r4]}A$
76: S$[37,43]}B$
77: S$[44,50]}C$
78: wrt 718,"f140.::"
79: if flg1;wrt 718,"nf1,:cs2,:pe0,:pa330,500;"
80: if flg2;wrt 718,"nf1,:cs2,:pe0,::pa410,500;"
81: if flg3;wrt 718,"nf1,:cs2,:pe0,:pa375,500;"
82: wrt 718,"pe1,:tx",A$,char(3)
83: wrt 718,"nf2,:cs2,:pe0,:pa410,475;"
84: wrt 718,"pe1,:pa670,475;"
85: wrt 718,"pe0,:pa410,500;"
86: wrt 718,"pe1,:tx",B$,char(3),"::sn::"
87: wrt 718,"nf3,:pe0,:pa410,500;"
88: wrt 718,"bf3,"
89: wrt 718,"pe1,:tx",C$,char(3),"::sn::"
90: dsp A$,B$,C$,"Tr",H,"RT",F
91: wti 0,2;wtc 2,40;cfg 4,10,11,12,13
92: wrt 718,"uf4,";wrt 718,"uf5,"
93: gto +0;rdi 5}r5;if r5>32;gto +1
94: wrt 718,"bf4,";wait r10
95: if flg14;gto "Prm"
96: if flg6;gto "LEX"
97: wrt 718,"uf1,"
98: wait r11
99: wrt 718,"bf1,"
100: wait r12
101: wrt 718,"uf2,";wrt 9,"U2C"
102: if flg9;gto "Prm"
103: wti 0,2;wtc 2,40
104: eir 2
105: gto +0;if flg13 or flg11;gto +1
106: wrt 718,"bf2,";wrt 9,"U2V";red 9,P
```

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```
107: "Frm":if not flg14 and not flg9;gto +5
108: wrt 718,"uf2."
109: wait r12
110: wrt 718,"bf2."
111: wait r11;if flg14 or flg9;gto +2
112: wrt 718,"uf4,";wait r13
113: "LEX":wtc 2,40;eir 2
114: if flg6 or flg14 or flg9;sfg 4
115: wrt 718,"bf4,";wrt 9,"U2C"
116: wti 4,6
117: wrt 718,"uf3."
118: wti 4,8
119: gto +0;if flg12 or flg13;gto +2
120: wrt 718,"bf3."
121: "EM":wrt 718,"ef1,::ef2,::ef3,::"
122: if flg6 or flg14 or flg9;gto +5
123: if Z=1;if flg10;F+.01→F;P+.01→P
124: if Z=1;if flg11;F+.02→F;P+.02→P;-1*P→P
125: if Z=2;if flg10;F+.04→F;P+.04→P;-1*P→P
126: if Z=2;if flg11;F+.03→F;P+.03→P
127: 2→r9
128: if H<169;1→r9
129: if not flg6 and not flg9 and not flg14;r9/1000+P→P
130: r9/1000+F→F
131: if flg7;gto "LO"
132: if Y<5;if flg13;-1*F→F
133: if Y>4;if flg12;-1*F→F
134: "LX":if Z=1;F→T[X,Y]
135: if Z=2;F→T[X,Y+6];if flg6 or flg14 or flg9;gto +3
136: "LO":if Z=1;P→V[X,Y]
137: if Z=2;P→V[X,Y+6]
138: if flg5;if r20=48;cfg 5;0→r20;gto "J"
139: next H
140: if flg7;gto +5
141: asgn K$,4
142: rread 4,1;sprt 4,T[*]
143: F[2]+1→F[2]
144: if flg6 or flg14 or flg9;gto +3
145: asgn J$,5
146: rread 5,1;sprt 5,V[*]
147: fmt 2,6f10.2
148: drive 0
149: "END":beep;wait 300;beep;wait 300;beep;wait 500
150: "I2":if flg4;wrt 9,"U2V";red 9,F
151: rdi 4→r5;if flg4;gto +3
152: if bit(0,r5);sfg 10;sfg 4;iret
153: if bit(1,r5);sfg 11;sfg 4;iret
154: if bit(0,r5);sfg 12;iret
155: if bit(1,r5);sfg 13;iret
*30463
```

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APPENDIX C

INSTRUCTIONS TO SUBJECTS: LEXICAL AND LEVELS DECISIONS

Semantic Decision

Part A

The following is a list of definitions for some categories. Look these over and tell me if you find any of these definitions unclear.

Time	Any unit of time
Utensil	Kitchen utensils
Body	Any part of the body
Building	Any part of a building
Music	Musical instruments
Money	Any form of currency
Relative	Any family relations
Speech	Any part of speech
Metal	Any type of metal
Animal	Any animal
Colour	Any colour
Furniture	Any type of furniture
Fruit	Any type of fruit
Weapon	Any type of weapon
Dwelling	Anything people live in
Alcohol	Any alcoholic beverage
Crime	Any type of crime
Clergy	Any religious official

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Geology	Any geological formation
Weather	Any weather phenomena
Clothing	Any article of clothing
Tree	Any type of tree
Fish	Any type of fish
Bird	Any type of bird
Vegetable	Any type of vegetable
Vehicle	Any type of vehicle
Footwear	Anything people wear on their feet
Insect	Any kind of insect

Your task is quite simple. After you press the START button (E. demonstrates) , a category name and a question mark will appear on the screen for one half of a second. Following this, a word will appear on the screen before you. If this word is a member of the preceding category, I want you to quickly press the YES button (E. demonstrates). If this word is not a member of the preceding category, I want you to quickly press the NO button (E. demonstrates). Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment. One half of a second after you make a response to the category question, a letter string will appear on the screen. A letter string is a string of letters which is pronounceable. This letter string may or may not be an English word. If it is an English word, I want you to quickly press the YES button (E. demonstrates). If it is not an English word, I want you to quickly press the NO button (E. demonstrates). This is not a vocabulary test. If it is a word, it would be easily recognizable to a junior high school student. Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment. After you respond you can initiate the same sequences of events by pressing the START button(E. demonstrates). There are 40 practice trials followed by 336 real trials. Work at your own pace. After the first 40 trials I will come in and ask you if you have any problems. On the average, people take 3/4 of an hour to finish. Any questions?

Phonemic Decision

Part A

Your task is quite simple. After you press the START button, a word and a question mark will appear on the screen for one half of a second. Following this, another word will appear on the screen before you. If this word rhymes with the preceding word, I want you to quickly press the YES button (E. demonstrates). If this word does not rhyme with the preceding word, I want you to quickly press the NO button (E. demonstrates). Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment.

One half of a second after you make a response to the rhyme question, a letter string will appear on the screen. A letter string is a string of letters which is pronounceable. This letter string may or may not be an English word. If it is an English word, I want you to quickly press the YES button (E. demonstrates). If it is not an English word, I want you to press the NO button (E. demonstrates). This is not a vocabulary test. If it is a word, it would be easily recognizable to a junior high school student. Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment. After you respond you can initiate the same sequences of events by pressing the START button(E. demonstrates) . There are 40 practice trials followed by 336 real trials. Work at your own pace. After the first 40 trials I will come in and ask you if you have any problems. On the average, people take 3/4 of an hour to finish. Any questions?

Structural Decision

Part A

Your task is quite simple. After you press the START button(E. demonstrates) a letter and a question mark will appear on the screen before you for one half of a second. Following this, a word will appear on the screen before you. If this word contains the target letter (the letter which appeared with the question mark), I want you to quickly press the YES button (E. demonstrates). If this word does not contain the target letter, I want you to quickly press the NO button . Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment.

One half of a second after you make a response to the category question, a letter string will appear on the screen. A letter string is a string of letters which is pronounceable. If it is an English word, I want you to quickly press the YES button (E. demonstrates). If it is not an English word, I want you to quickly press the NO button (E. demonstrates). This is not a vocabulary test. If it is a word, it would be easily recognizable to a junior high school student. Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment. after you respond you can initiate the same sequences of events by pressing the START button(E. demonstrates) . There are 40 practice trials followed by 336 real trials. Work at your own pace. After the first 40 trials I will come in and ask you if you have any problems. On the average, people take 3/4 of an hour to finish.

Any questions?

Double Prime

Part A

Your task is quite simple After you press the START button (E. demonstrates), a word will appear on the screen for one half or a second. Pay attention to this word but do not respond to it. After another interval another word will appear on the screen for one half of a second. Again, pay attention to this word but do not respond to it. After an interval of one half of a second a letter string will appear on the screen. A letter string is a string of letters which is prounceable. This letter string may or may not be an English word. If it is an English word, I want you to quickly press the YES button (E. demonstrates). If it is not a word, I want you to quickly press the NO button (E. demonstrates). This is not a vocabulary test. If it is a word, it would be easily recognizable to a junior high school student. Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment. After you respond you can initiate the same sequences of events by pressing the START button (E. demonstrates). There are 40 practice trials followed by 336 real trials. Work at your own pace. After the first 40 trials I will come in and ask you if you have any problems. On the average, people take 3/4 of an hour to finish. Any questions?

Prime Alone

Part A

After you press the START button (E. demonstrates), a word will appear on the screen for one half of a second. Pay attention to this word but do not respond to it. After an interval of one half of a second a letter string will appear on the screen. A letter string is a string of letters which is pronouncable. This letter string may or may not be an English word. If it is an English word, I want you to quickly press the YES button (E. demonstrates). If it is not a word, I want you to quickly press the NO button (E. demonstrates). This is not a vocabulary test. If it is a word, it would be easily recognizable to a junior high school student. Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment. After you respond you can initiate the same sequences of events by pressing the START button (E. demonstrates). There are 40 practice trials followed by 336 real trials. Work at your own pace. After the first 40 trials I will come in and ask you if you have any problems. On the average, people take 3/4 of an hour to finish.

Any questions?

Lexical Alone

Part A

After you press the START button (E. demonstrates), a letter string will appear on the screen. A letter string is a string of letters which is pronouncable. This letter string may or may not be an English word. If it is an English word, I want you to quickly press the YES button (E. demonstrates). If it is not a word, I want you to quickly press the NO button (E.

demonstrates). This is not a vocabulary test. If it is a word, it would be easily recognizable to a junior high school student. Try to be correct, then respond quickly. If you make an occasional error, do not worry. Do not slow down. Try to respond quickly throughout the experiment. after you respond you can initiate the same sequences of events by pressing the START button (E. demonstrates). There are 40 practice trials followed by 336 real trials. Work at your own pace. After the first 40 trials I will come in and ask you if you have any problems. On the average, people take 3/4 of an hour to finish.
Any questions?

For all conditions at the end of the practice session: Just to reiterate, this is not evaluative in any way. We are simply interested in how people make these types of decisions. Try to relax. Do not worry about an occasional error. The last thing I want you to do is to make an error and then immediately slow down. Any questions?

APPENDIX D

INSTRUCTIONS TO SUBJECTS: ARITHMETIC TASK

Part B

Now I want you to add up this column of figures. Write down the answer at the bottom. Double check to see if you are correct. I will return in one minute.

04
21
23
16
11
10
09
07
06
23
13
17
15
14

APPENDIX E

INSTRUCTIONS TO SUBJECTS: RECALL TASK

Semantic Decision

Part C

Thank you for your cooperation so far. Now I have a task for you that will take only a few minutes to do. On the sheet of paper before you, I want you to write down all the words and nonwords for which you made a decision. Try to remember as many as possible, but do not guess. For example, for the sequence headgear ?, box, pencil, you should write down the words *box* and *pencil*. If you recall only one item, (e.g., *pencil*) write it down. I will give you five minutes to complete this task.

Phonemic Decision

Part C

Thank you for your cooperation so far. Now I have a task for you that will take only a few minutes to do. On the sheet of paper before you, I want you to write down all the words and nonwords for which you made a decision. Try to remember as many as possible, but do not guess. For example, for the sequence *page ?, box, pencil*, you should write down the words *box* and *pencil*. If you recall only one item, (e.g., *pencil*) write it down. I will give you five minutes to complete this task.

Structural Decision

Part C

Thank you for your cooperation so far. Now I have a task for you that will take only a few minutes to do. On the sheet of paper before you, I want you to write down all the words and nonwords for which you made a decision. Try to remember as many as possible, but do not guess. For example, for the sequence *h* , *box*, *pencil*, you should write down the words *box* and *pencil*. If you recall only one item, (e.g., *pencil*) write it down. I will give you five minutes to complete this task.

Double Prime

Part C

Thank you for your cooperation so far. Now I have a task for you that will take only a few minutes to do. On the sheet of paper before you, I want you to write down all the second and third items of each sequence you saw. Try to remember as many as possible, but do not guess. For example, for the sequence *headgear ?*, *box*, *pencil*, you should write down the words *box* and *pencil*. If you recall only one item, (e.g., *pencil*) write it down. I will give you five minutes to complete this task.

Prime Alone

Part C

Thank you for your cooperation so far. Now I have a task for you that will take only a few minutes to do. On the sheet of paper before you, I want you to write down all the words and nonwords that you saw. Try to remember as many as possible, but do not guess. For example, for the sequence *box*, *pencil*, you should write down the words *box* and *pencil*. If you recall only one item, (e.g., *pencil*) write it down. I will give you five minutes to complete this task.

Lexical Alone

Part C

Thank you for your cooperation so far. Now I have a task for you that will take only a few minutes to do. On the sheet of paper before you, I want you to write down all the words and nonwords that you saw. Try to remember as many as possible, but do not guess. For example, if you saw *pencil*, you should write down *pencil*. I will give you five minutes to complete this task.

APPENDIX F

INSTRUCTIONS TO SUBJECTS: SELF-REPORTED AWARENESS

Part D

1. Did you notice any relationship(s) between the second and third words(first and second words) of each sequence that you saw. If so, what?

2. On what percent of the trials would you estimate that this (these) relationship(s) occurred?

APPENDIX G

PERCENT OF LEXICAL ITEMS DELETED CONTROL CONDITIONS: WORD TRIALS

Relationship	Decision Type	Level		
		Double Prime	Prime Alone	Lexical Alone
Associative	Yes	3.6	1.7	1.7
	No	1.4	1.9	3.6
	$\overline{X}$	2.5	1.8	2.7
Rhyme	Yes	2.4	3.1	1.7
	No	1.4	2.4	2.4
	$\overline{X}$	1.9	2.8	2.1
Physical	Yes	3.4	1.2	3.8
	No	3.6	1.4	3.4
	$\overline{X}$	3.5	1.3	3.6

(continued)

APPENDIX G (CONT'D)

PERCENT OF LEXICAL ITEMS DELETED CONTROL CONDITIONS: WORD TRIALS

Relationship	Decision Type	Level		
		Double Prime	Prime Alone	Lexical Alone
Neutral	Yes	1.7	3.4	3.4
	No	3.1	2.2	1.7
	$\overline{X}$	2.4	2.8	2.6
Mean	Yes	2.8	2.3	2.5
	No	2.4	2.0	2.8
	$\overline{X}$	2.6	2.2	2.7

Note. Percent errors shown in parentheses.

APPENDIX H

PERCENT OF LEXICAL ITEMS DELETED STANDARD ORIENTING CONDITIONS: WORD TRIALS

Relationship	Decision Type	Level			
		Semantic	Phonemic	Structural	Mean
Associative	Yes	2.4	2.6	3.1	2.7
	No	3.4	4.1	3.1	3.5
	$\overline{X}$	2.9	3.4	3.1	3.1
Rhyme	Yes	1.9	2.4	1.9	2.1
	No	2.6	3.6	2.6	3.0
	$\overline{X}$	2.3	3.0	2.3	2.5
Physical	Yes	2.2	2.2	1.7	2.0
	No	2.8	2.5	2.4	2.6
	$\overline{X}$	2.8	2.5	2.4	2.6

(continued)

APPENDIX H (CONT'D)

PERCENT OF LEXICAL ITEMS DELETED STANDARD ORIENTING CONDITIONS: WORD TRIALS

Relationship	Decision Type	Semantic	Phonemic	Structural	Mean
Neutral	Yes	3.6	2.2	0.7	2.2
	No	4.6	3.4	2.8	3.6
	$\overline{X}$	4.1	2.8	1.8	2.9
Mean	Yes	2.5	2.3	1.9	2.2
	No	3.5	3.5	2.9	3.3
	$\overline{X}$	3.0	2.9	2.4	

Note. Percent Errors shown in parentheses.

APPENDIX I

PERCENT OF LEVELS DELETED STANDARD ORIENTING CONDITIONS: WORD TRIALS

Relationship	Decision Type	Level			
		Semantic	Phonetic	Structural	$\overline{X}$
Associative	Yes	2.9	1.2	2.4	2.4
	No	2.6	1.4	1.4	1.4
	$\overline{X}$	2.8	1.3	1.9	2.0
Rhyme	Yes	3.4	2.9	3.4	3.4
	No	2.6	2.9	1.9	1.9
	$\overline{X}$	3.0	2.9	2.7	2.8
Physical	Yes	2.9	3.6	1.2	1.2
	No	4.1	3.4	3.6	3.6
	$\overline{X}$	3.5	3.5	2.4	3.1

(continued)

APPENDIX I (CONT'D)

PERCENT OF LEVELS DELETED STANDARD ORIENTING CONDITIONS: WORD TRIALS

		Semantic	Phonetic	Structural	Mean
Neutral	Yes	2.9	1.2	1.9	1.9
	No	4.3	1.9	3.1	3.1
	$\overline{X}$	3.6	1.6	2.5	2.6
Mean	Yes	3.0	2.2	2.2	2.5
	No	3.4	2.4	2.5	2.8
	$\overline{X}$	3.2	2.3	2.4	2.7

Note. Percent errors shown in parentheses

APPENDIX J

PERCENT OF LEXICAL ITEMS DELETED NONWORD TRIALS

Decision Type	Level			
	Lexical Alone	Prime Alone	Double Prime	Mean
Yes	1.6	1.7	1.8	-
No	1.8	2.4	1.9	-
Mean				
	Semantic	Phonemic	Structural	
Yes	2.5	4.1	2.0	2.8
No	1.9	1.4	1.9	1.7
Mean	2.2	2.7	2.0	2.3

APPENDIX K

PERCENT OF LEVELS ITEMS DELETED: NONWORD TRIALS

Decision Type	Level			
	Semantic	Phonemic	Structural	Mean
Yes	3.6	1.7	2.3	2.5
No	2.5	2.3	2.2	2.3
Mean	3.1	2.0	2.3	2.4

APPENDIX L.1

ANALYSIS OF VARIANCE OF LEVELS

DECISIONS LATENCIES

SOURCE	DF	MS	F	P
A (LEVEL)	2.	67328.000	0.247	0.783
S-WITHIN	45.	273095.063		
B (ORDER)	1.	980480.000	47.995	0.001
AB	2.	18688.000	0.915	0.408
BS-WITHIN	45.	20428.797		
C (DECISION)	1.	1755392.000	72.518	0.001
AC	2.	8960.000	0.370	0.693
CS-WITHIN	45.	24206.219		
BC	1.	3584.000	0.409	0.526
ABC	2.	17408.000	1.984	0.149
BCS-WITHIN	45.	8772.266		
D (RELATIONSHIP)	3.	8533.332	1.573	0.199
AD	6.	17194.664	3.169	0.006
DS-WITHIN	135.	5425.301		
BD	3.	1621.333	0.303	0.823
ABD	6.	2048.000	0.382	0.889
BDS-WITHIN	135.	5357.035		
CD	3.	16554.664	1.701	0.170
ACD	6.	10026.664	1.031	0.408
CDS-WITHIN	135.	9729.895		

APPENDIX L.2

ANALYSIS OF VARIANCE OF LEVELS

DECISION ERROR RATES

SOURCE	DF	MS	F	P
A (LEVEL)	2.	117.246	0.581	0.563
S-WITHIN	45.	201.717		
B (ORDER)	1.	127.125	3.240	0.079
AB	2.	25.869	0.659	0.522
BS-WITHIN	45.	39.231		
C (DECISION TYPE)	1.	380.410	4.270	0.045
AC	2.	88.391	0.992	0.379
CS-WITHIN	45.	89.092		
BC	1.	10.645	0.196	0.660
ABC	2.	32.969	0.606	0.550
BCS-WITHIN	45.	54.402		
D (RELATIONSHIP)	3.	10.280	0.370	0.775
AD	6.	9.279	0.334	0.918
DS-WITHIN	135.	27.789		
BD	3.	66.310	2.201	0.091
ABD	6.	12.637	0.419	0.865
BDS-WITHIN	135.	30.131		
CD	3.	14.432	0.496	0.686
ACD	6.	33.663	1.156	0.334
CDS-WITHIN	135.	29.119		

APPENDIX L.3

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCY IN THE LEXICAL ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	32833.066		
A (ORDER)	1.	33328.000	4.393	0.053
AS-WITHIN	15.	7586.133		
B (DECISION TYPE)	1.	2128.000	1.365	0.261
BS-WITHIN	15.	1559.467		
AB	1.	1248.000	0.589	0.455
ABS-WITHIN	15.	2119.467		
C (RELATIONSHIP)	3.	2229.333	1.399	0.256
CS-WITHIN	45.	1593.955		
AC	3.	746.667	0.347	0.792
ACS-WITHIN	45.	2152.533		
BC	3.	1722.667	0.880	0.459
BCS-WITHIN	45.	1957.689		
ABC	3.	320.000	0.176	0.912
ABCS-WITHIN	45.	1819.733		

APPENDIX L.4

ANALYSIS OF VARIANCE OF LEXICAL DECISION ERROR RATE IN THE LEXICAL ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	39.124		
A (ORDER)	1.	13.957	9.197	0.008
AS-WITHIN	15.	1.518		
B (DECISION TYPE)	1.	7.953	1.282	0.275
BS-WITHIN	15.	6.202		
AB	1.	26.609	1.209	0.289
ABS-WITHIN	15.	22.014		
C (RELATIONSHIP)	3.	47.886	2.334	0.087
CS-WITHIN	45.	20.517		
AC	3.	17.149	1.562	0.212
ACS-WITHIN	45.	10.981		
BC	3.	11.033	1.305	0.285
BCS-WITHIN	45.	8.458		
ABC	3.	27.965	2.421	0.078
ABCS-WITHIN	45.	11.549		

APPENDIX L.5

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCIES IN THE PRIME ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	81431.438		
A (ORDER)	1.	162768.000	15.731	0.001
AS-WITHIN	15.	10346.664		
B (DECISION TYPE)	1.	80.000	0.039	0.846
BS-WITHIN	15.	2050.133		
AB	1.	816.000	0.325	0.577
ABS-WITHIN	15.	2513.067		
C (RELATIONSHIP)	3.	40442.664	17.695	0.001
CS-WITHIN	45.	2285.511		
AC	3.	746.667	0.513	0.675
ACS-WITHIN	45.	1455.644		
BC	3.	298.667	0.194	0.900
BCS-WITHIN	45.	1543.111		
ABC	3.	544.000	0.297	0.827
ABCS-WITHIN	45.	1831.111		

APPENDIX L.6

ANALYSIS OF VARIANCE OF LEXICAL DECISION ERROR RATE IN THE PRIME ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	29.626		
A (ORDER)	1.	2.881	0.321	0.580
AS-WITHIN	15.	8.983		
B (DECISION TYPE)	1.	28.056	2.770	0.117
BS-WITHIN	15.	10.128		
AB	1.	9.643	1.126	0.305
ABS-WITHIN	15.	8.564		
C (RELATIONSHIP)	3.	104.332	5.232	0.003
CS-WITHIN	45.	19.941		
AC	3.	20.756	1.516	0.223
BC	3.	13.518	1.460	0.238
BCS-WITHIN	45.	9.257		
ABC	3.	13.783	0.868	0.465
ABCS-WITHIN	45.	15.877		

APPENDIX L.7

ANALYSIS OF VARIANCE OF THE LEXICAL DECISION LATENCY IN THE DOUBLE PRIME CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	14.	144337.125		
A (ORDER)	1.	115200.000	24.425	0.001
AS-WITHIN	14.	4716.570		
B (DECISION TYPE)	1.	3720.000	2.291	0.152
BS-WITHIN	14.	1624.000		
AB	1.	855.000	0.714	0.412
ABS-WITHIN	14.	1197.714		
C (RELATIONSHIP)	3.	23485.000	8.599	0.001
CS-WITHIN	42.	2731.048		
AC	3.	1035.000	0.984	0.409
ACS-WITHIN	42.	1051.428		
BC	3.	660.000	0.469	0.705
BCS-WITHIN	42.	1406.857		
ABC	3.	2525.000	1.439	0.245
ABCS-WITHIN	42.	1755.048		

APPENDIX L.8

ANALYSIS OF VARIANCE OF THE LEXICAL DECISION ERROR RATE IN THE DOUBLE PRIME CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	14.	57.713		
A (ORDER)	1.	172.559	8.041	0.013
AS-WITHIN	14.	21.460		
B (DECISION TYPE)	1.	81.339	4.067	0.063
BS-WITHIN	14.	20.000		
AB	1.	16.335	0.840	0.375
ABS-WITHIN	14.	19.450		
C (RELATIONSHIP)	3.	219.874	9.008	0.001
CS-WITHIN	42.	24.408		
AC	3.	43.975	4.972	0.005
ACS-WITHIN	42.	8.844		
BC	3.	45.394	2.284	0.093
BCS-WITHIN	42.	19.876		
ABC	3.	10.536	0.372	0.774
ABCS-WITHIN	42.	28.338		

APPENDIX L.9

ANALYSIS OF VARIANCE OF THE LEXICAL DECISION LATENCY IN THE THREE STANDARD LEVELS

SOURCE	DF	MS	F	P
A (LEVEL)	2.	312576.000	1.975	0.151
S-WITHIN	45.	158253.500		
B (ORDER)	1.	980224.000	67.518	0.001
AB	2.	58624.000	4.038	0.024
BS-WITHIN	45.	14518.043		
C (DECISION TYPE)	1.	86528.000	5.965	0.019
AC	2.	8448.000	0.582	0.563
CS-WITHIN	45.	14506.664		
BC	1.	1280.000	0.171	0.681
ABC	2.	896.000	0.120	0.887
BCS-WITHIN	45.	7463.820		
D (RELATIONSHIP)	3.	3413.333	0.577	0.631
AD	6.	8874.664	1.501	0.182
DS-WITHIN	135.	5910.754		
BD	3.	3157.333	0.679	0.566
ABD	6.	8618.664	1.854	0.093
BDS-WITHIN	135.	4647.820		
CD	3.	47445.332	9.019	0.001
ACD	6.	13482.664	2.563	0.022
CDS-WITHIN	135.	5260.324		

APPENDIX L.10

ANALYSIS OF VARIANCE OF THE LEXICAL DECISION ERROR RATE IN THE THREE STANDARD LEVELS

SOURCE	DF	MS	F	P
A (LEVEL)	2.	93.400	1.006	0.374
S-WITHIN	45.	92.831		
B (ORDER)	1.	8.719	0.417	0.522
AB	2.	16.553	0.792	0.459
BS-WITHIN	45.	20.890		
C (DECISION TYPE)	1.	1363.840	26.913	0.001
AC	2.	8.463	0.167	0.847
CS-WITHIN	45.	50.677		
BC	1.	104.547	4.344	0.043
ABC	2.	16.754	0.696	0.504
BCS-WITHIN	45.	24.068		
D (RELATIONSHIP)	3.	56.150	1.953	0.124
AD	6.	35.320	1.229	0.296
DS-WITHIN	135.	28.750		
BD	3.	7.814	0.385	0.764
ABD	6.	22.766	1.122	0.353
BDS-WITHIN	135.	20.296		
CD	3.	108.275	4.668	0.004
ACD	6.	31.683	1.366	0.233
CDS-WITHIN	135.	23.195		

APPENDIX L.11

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCIES FOR FAST AND SLOW GROUPS

SOURCE	DF	MS	F	P
A (LEVEL)	2.	312512.000	2.588	0.087
B (GROUP)	1.	1314304.000	10.883	0.002
AB	2.	367424.000	3.042	0.058
S-WITHIN	42.	120771.000		
C (ORDER)	1.	980096.000	63.758	0.001
AC	1.	58688.000	3.818	0.030
BC	1.	128.000	0.008	0.928
ABC	2.	3712.000	0.241	0.787
CS-WITHIN	42.	15372.188		
D (DECISION TYPE)	1.	86528.000	5.915	0.019
AD	2.	8448.000	0.577	0.566
BD	1.	25216.000	1.724	0.196
ABD	2.	6784.000	0.464	0.632
DS-WITHIN	42.	14628.570		
CD	1.	1280.000	0.164	0.687
ACD	2.	960.000	0.123	0.884
BCD	1.	2688.000	0.345	0.560
ABCD	2.	2880.000	0.370	0.693
CDS-WITHIN	42.	7789.711		
E (RELATIONSHIP)	3.	3413.333	0.568	0.637
AE	6.	8896.000	1.481	0.190
BE	3.	384.000	0.064	0.979

(cont'd)

APPENDIX L.11

SOURCE	DF	MS	F	P
ABE	6.	6656.000	1.108	0.361
ES-WITHIN	126.	6005.840		
CE	3.	3157.333	0.674	0.570
ACE	6.	8618.664	1.839	0.097
BCE	3.	5504.000	1.174	0.322
ABCE	6.	3456.000	0.737	0.621
CES-WITHIN	126.	4687.234		
DE	3.	47445.332	8.920	0.001
ADE	6.	13482.664	2.535	0.024
BDE	3.	6016.000	1.131	0.339
ABDE	6.	3584.000	0.674	0.671
DES-WITHIN	126.	5319.109		
CDE	3.	5717.332	1.607	0.191
ACDE	6.	768.000	0.216	0.971
BCDE	3.	1920.000	0.540	0.656
ABCDE	6.	2026.667	0.570	0.754
CDES-WITHIN	126.	3557.587		

APPENDIX L.12

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCY FOR THE FAST GROUP IN THE SEMANTIC CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	7.	59977.141		
A (ORDER)	1.	288520.000	36.898	0.001
AS-WITHIN	7.	7819.426		
B (DECISION TYPE)	1.	9712.000	0.603	0.463
BS-WITHIN	7.	16105.141		
AB	1.	1088.00	0.101	0.759
ABS-WITHIN	7.	10729.141		
C (RELATIONSHIP)	3.	7000.000	2.127	0.127
CS-WITHIN	21.	3290.667		
AC	3.	1208.000	1.556	0.230
ACS-WITHIN	21.	776.381		
BC	3.	8245.332	4.281	0.017
BCS-WITHIN	21.	1926.085		
ABC	3.	1125.333	0.569	0.641
ABCS-WITHIN	21.	1976.381		

APPENDIX L.13

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCY FOR THE SLOW GROUP IN THE SEMANTIC CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	7	108841.125		
A (ORDER)	1.	392168.000	22.971	0.002
AS-WITHIN	7.	17072.000		
B (DECISION TYPE)	1.	10064.000	0.971	0.357
BS-WITHIN	7.	10361.141		
AB	1.	48.000	0.003	0.958
ABS-WITHIN	7.	16219.426		
C (RELATIONSHIP)	3.	4760.000	0.659	0.586
CS-WITHIN	21.	7222.855		
AC	3.	8773.332	1.082	0.378
ACS-WITHIN	21.	8110.473		
BC	3.	3522.667	0.356	0.365
BCS-WITHIN	21.	9895.617		
ABC	3.	2122.667	0.680	0.574
ABCS-WITHIN	21.	3123.809		

APPENDIX L.14

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCY FOR THE FAST GROUP IN THE PHONEMIC CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	7.	202137.125		
A (ORDER)	1.	174344.000	11.674	0.011
AS-WITHIN	7.	14934.855		
B (DECISION TYPE)	1.	23872.000	0.761	0.412
BS-WITHIN	7.	31364.570		
AB	1.	320.000	0.053	0.824
ABS-WITHIN	7.	6016.000		
C (RELATIONSHIP)	3.	3264.000	1.018	0.405
CS-WITHIN	21.	3206.857		
AC	3.	12666.664	2.927	0.057
ACS-WITHIN	21.	4326.855		
BC	3.	13080.000	2.463	0.091
BCS-WITHIN	21.	5310.473		
ABC	3.	5218.664	1.208	0.331
ABCS-WITHIN	21.	4320.762		

APPENDIX L.15

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCY FOR THE SLOW GROUP IN THE PHONEMIC CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	7.	87474.250		
A (ORDER)	1.	132680.000	7.574	0.028
AS-WITHIN	7.	17517.711		
B (DECISION TYPE)	1.	344.000	0.038	0.852
BS-WITHIN	7.	9142.855		
AB	1.	8624.000	1.729	0.230
ABS-WITHIN	7.	4987.426		
C (RELATIONSHIP)	3.	10346.664	0.849	0.483
CS-WITHIN	21.	12188.949		
AC	3.	4594.664	0.615	0.613
ACS-WITHIN	21.	7469.711		
BC	3.	38602.664	6.216	0.003
BCS-WITHIN	21.	6210.285		
ABC	3.	1669.333	0.298	0.827
ABCS-WITHIN	21.	5603.809		

APPENDIX L.16

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCY FOR THE FAST GROUP IN THE STRUCTURAL CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	7.	152441.125		
A (ORDER)	1.	74496.000	3.079	0.123
AS-WITHIN	7.	24192.000		
B (DECISION TYPE)	1.	91160.000	6.567	0.037
BS-WITHIN	7.	13881.141		
AB	1.	1184.000	0.404	0.545
ABS-WITHIN	7.	2928.000		
C (RELATIONSHIP)	3.	4914.664	1.257	0.314
CS-WITHIN	21.	3908.571		
AC	3.	402.667	0.116	0.950
ACS-WITHIN	21.	3463.619		
BC	3.	5482.664	1.865	0.166
BCS-WITHIN	21.	2939.428		
ABC	3.	1584.000	0.628	0.605
ABCS-WITHIN	21.	2521.143		

APPENDIX L.17

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCY FOR THE SLOW GROUP IN THE STRUCTURAL CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	7.	113997.688		
A (ORDER)	1.	42808.000	3.980	0.086
AS-WITHIN	7.	10756.570		
B (DECISION TYPE)	1.	7000.000	1.014	0.348
BS-WITHIN	7.	6905.141		
AB	1.	408.000	0.070	0.799
ABS-WITHIN	7.	5814.855		
C (RELATIONSHIP)	3.	4592.000	0.738	0.541
CS-WITHIN	21.	6220.949		
AC	3.	5194.664	1.318	0.295
ACS-WITHIN	21.	3941.338		
BC	3.	18696.000	3.308	0.040
BCS-WITHIN	21.	5652.570		
ABC	3.	1477.333	0.386	0.764
ABCS-WITHIN	21.	3830.857		

APPENDIX M.1

ANALYSIS OF VARIANCE OF LEVELS DECISIONS

LATENCY PRECEDING RHYME RELATIONSHIP TRIALS

SOURCE	DF	MS	F	P
A (LEVEL)	2.	38584.000	0.302	0.741
S-WITHIN	45.	127607.438		
B (ORDER)	1.	410352.000	17.889	0.001
AB	2.	2808.000	0.122	0.885
BS-WITHIN	45.	22938.664		
C (VISUAL SIMILARITY)	1.	7440.000	0.761	0.388
AC	2.	7856.000	0.803	0.454
CS-WITHIN	45.	9779.199		
BC	1.	20464.000	2.082	0.156
ABC	2.	10608.000	1.079	0.349
BCS-WITHIN	45.	9830.043		
D (DECISION TYPE)	1.	914064.000	43.640	0.001
AD	2.	2984.000	0.142	0.868
DS-WITHIN	45.	20945.422		
BD	1.	976.000	0.077	0.783
ABD	2.	2472.000	0.195	0.824
BDS-WITHIN	45.	12698.309		
CD	1.	6160.000	1.082	0.304
ACD	2.	7760.000	1.363	0.266
CDS-WITHIN	45.	5692.797		

APPENDIX M.2

ANALYSIS OF VARIANCE OF LEVELS DECISIONS

ERROR RATE PRECEDING RHYME RELATIONSHIP TRIALS

SOURCE	DF	MS	F	P
A (LEVEL)	2.	25.53	0.175	0.840
S-WITHIN	45.	145.974		
B (ORDER)	1.	5.387	0.103	0.749
AB	2.	31.438	0.604	0.551
BS-WITHIN	45.	52.073		
C	1.	65.879	1.181	0.283
AC (VISUAL SIMILARITY)	2.	41.779	0.749	0.479
CS-WITHIN	45.	55.785		
BC	1.	27.422	0.370	0.546
ABC	2.	55.855	0.754	0.476
BCS-WITHIN	45.	74.057		
D (DECISION TYPE)	1.	331.728	2.958	0.092
AD	2.	132.607	1.188	0.316
BD	1.	24.574	0.244	0.624
ABD	2.	45.795	0.454	0.638
BDS-WITHIN	45.	100.898		
CD	1.	85.492	1.336	0.254
ACD	2.	47.779	1.336	0.254
CDS-WITHIN	45.	63.995		

APPENDIX M.3

ANALYSIS OF VARIANCE OF LEXICAL DECISIONS LATENCIES ON RHYME RELATIONSHIP TRIALS IN THE LEXICAL ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	20618.664		
A (ORDER)	1.	23136.000	3.414	0.084
AS-WITHIN	15.	6777.598		
B (VISUAL SIMILARITY)	1.	7232.000	4.134	0.060
BS-WITHIN	15.	1749.333		
AB	1.	176.000	0.105	0.750
ABS-WITHIN	15.	1673.600		
C (DECISION TYPE)	1.	12032.000	2.286	0.151
CS-WITHIN	15.	5264.000		
AC	1.	208.000	0.073	0.791
ACS-WITHIN	15.	2850.133		
BC	1.	4288.000	2.894	0.110
BCS-WITHIN	15.	1481.600		
ABC	1.	224.000	0.331	0.573
ABCS-WITHIN	15.	676.267		

APPENDIX M.4

ANALYSIS OF VARIANCE OF LEXICAL DECISIONS ERROR RATES ON RHYME RELATIONSHIP TRIALS IN THE LEXICAL ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	37.517		
A (ORDER)	1.	0.335	0.015	0.905
AS-WITHIN	15.	22.506		
B (VISUAL SIMILARITY)	1.	5.408	0.117	0.737
BS-WITHIN	15.	46.358		
AB	1.	0.025	0.001	0.977
ABS-WITHIN	15.	28.933		
C (DECISION TYPE)	1.	6.431	0.238	0.633
CS-WITHIN	15.	27.051		
AC	1.	73.544	3.087	0.099
ACS-WITHIN	15.	23.826		
BC	1.	3.162	0.158	0.697
BCS-WITHIN	15.	20.069		
ABC	1.	7.775	0.415	0.529
ABCS-WITHIN	15.	18.743		

APPENDIX M.5

ANALYSIS OF VARIANCE OF LEXICAL DECISIONS LATENCIES ON RHYME RELATIONSHIP TRIALS IN THE THREE STANDARD CONDITIONS

SOURCE	DF	MS	F	P
S-WITHIN	15.	42533.332		
A (ORDER)	1.	80048.000	10.854	0.005
AS-WITHIN	15.	7374.930		
B (VISUAL SIMILARITY)	1.	416.000	0.139	0.714
BS-WITHIN	15.	2984.533		
AB	1.	3920.000	2.767	0.117
ABS-WITHIN	15.	1416.533		
C (DECISION TYPE)	1.	576.000	0.234	0.636
CS-WITHIN	15.	2464.000		
AC	1.	144.000	0.066	0.801
ACS-WITHIN	15.	2198.400		
BC	1.	1376.000	0.989	0.336
BCS-WITHIN	15.	1390.933		
ABC	1.	11856.000	7.062	0.018
ABCS-WITHIN	15.	1678.933		

APPENDIX M.6

ANALYSIS OF VARIANCE OF LEXICAL DECISION ERROR RATES ON RHYME RELATIONSHIP TRIALS IN THE THREE STANDARD CONDITIONS

SOURCE	DF	MS	F	P
S-WITHIN	15.	51.199		
A (ORDER)	1.	48.230	1.255	0.280
AS-WITHIN	15.	38.416		
B (VISUAL SIMILARITY)	1.	120.679	1.994	0.178
BS-WITHIN	15.	60.525		
AB	1.	19.531	0.490	0.495
ABS-WITHIN	15.	39.857		
C (DECISION TYPE)	1.	38.542	0.820	0.379
CS-WITHIN	15.	46.998		
AC	1.	14.832	0.260	0.618
ACS-WITHIN	15.	57.094		
BC	1.	91.688	4.028	0.063
BCS-WITHIN	15.	22.764		
ABC	1.	33.008	0.642	0.436
ABCS-WITHIN	15.	51.440		

APPENDIX M.7

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCIES ON RHYME RELATIONSHIP TRIALS IN THE PRIME ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	14.	76958.813		
A (ORDER)	1.	50880.000	8.646	0.011
AS-WITHIN	14.	5884.570		
B (VISUAL SIMILARITY)	1.	2190.000	0.988	0.337
BS-WITHIN	14.	2216.000		
AB	1.	4095.000	0.817	0.381
ABS-WITHIN	14.	5013.711		
C (DECISION TYPE)	1.	9525.000	6.636	0.022
CS-WITHIN	14.	1435.428		
AC	1.	2190.000	0.743	0.403
ACS-WITHIN	14.	2948.571		
BC	1.	2520.000	0.886	0.363
BCS-WITHIN	14.	2845.714		
ABC	1.	2205.000	0.704	0.415
ABCS-WITHIN	14.	3130.286		

APPENDIX M.8

ANALYSIS OF VARIANCE OF LEXICAL DECISIONS ERROR RATES ON RHYME RELATIONSHIP TRIALS IN THE PRIME ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	14.	79.115		
A (ORDER)	1.	60.377	2.076	0.172
AS-WITHIN	14.	29.081		
B (VISUAL SIMILARITY)	1.	42.659	0.999	0.335
BS-WITHIN	14.	42.712		
AB	1.	30.119	0.590	0.455
ABS-WITHIN	14.	51.084		
C (DECISION TYPE)	1.	10.278	0.139	0.715
CS-WITHIN	14.	74.185		
AC	1.	0.411	0.003	0.954
ACS-WITHIN	14.	118.929		
BC	1.	0.853	0.014	0.909
BCS-WITHIN	14.	62.811		
ABC	1.	14.550	1.291	0.275
ABCS-WITHIN	14.	11.273		

APPENDIX M.9

ANALYSIS OF VARIANCE OF LEXICAL DECISIONS LATENCIES ON RHYME RELATIONSHIP TRIALS IN THE DOUBLE PRIME CONDITION

SOURCE	DF	MS	F	P
A (LEVEL)	2.	140784.000	1.847	0.170
S-WITHIN	45.	76232.125		
B (ORDER)	1.	612000.000	69.074	0.001
AB	2.	40928.000	4.619	0.015
BS-WITHIN	45.	8860.086		
C (VISUAL SIMILARITY)	1.	1440.000	0.223	0.639
AC	2.	1128.000	0.175	0.840
CS-WITHIN	45.	6453.332		
BC	1.	384.000	0.059	0.809
ABC	2.	312.000	0.048	0.953
BCS-WITHIN	45.	6487.820		
D (DECISION TYPE)	1.	11920.000	0.930	0.340
AD	2.	66440.000	5.186	0.009
DS-WITHIN	45.	12811.020		
BD	1.	928.000	0.130	0.720
ABD	2.	1496.000	0.210	0.812
BDS-WITHIN	45.	7134.930		
CD	1.	1952.000	0.488	0.488
ACD	2.	9136.000	2.285	9.113
CDS-WITHIN	45.	3997.866		

APPENDIX M.10

ANALYSIS OF VARIANCE OF LEXICAL DECISION ERROR RATES ON RHYME RELATIONSHIP TRIALS IN THE DOUBLE PRIME CONDITION

SOURCE	DF	MS	F	P
A (LEVEL)	2.	42.752	0.495	0.613
S-WITHIN	45.	86.361		
B (ORDER)	1.	67.662	2.011	0.163
AB	2.	15.679	0.466	0.630
BS-WITHIN	45.	33.641		
C (VISUAL SIMILARITY)	1.	78.026	1.258	0.268
AC	2.	28.578	0.461	0.634
CS-WITHIN	45.	62.038		
BC	1.	3.277	0.066	0.798
ABC	2.	44.552	0.897	0.415
BCS-WITHIN	45.	49.666		
D (DECISION TYPE)	1.	69.676	1.209	0.277
AD	2.	76.214	1.322	0.277
DS-WITHIN	45.	57.632		
BD	1.	130.722	2.723	0.106
ABD	2.	29.177	0.608	0.549
BDS-WITHIN	45.	48.013		
CD	1.	204.514	4.751	0.035
ACD	1.	11.536	0.268	0.766
CDS-WITHIN	45.	43.046		

APPENDIX N.1

ANALYSIS OF VARIANCE OF LEVELS DECISIONS LATENCIES PRECEDING NONWORD TRIALS

SOURCE	DF	MS	F	P
A(LEVEL)	2.	425.236	4.119	0.023
S-WITHIN	45.	103.227		
B(ORDER)	1.	100.656	1.721	0.196
AB	2.	18.594	0.318	0.729
BS-WITHIN	45.	58.481		
C(NONWORD TYPE)	1.	9.512	0.220	0.642
AC	2.	46.928	1.084	0.347
CS-WITHIN	45.	43.296		
BC	1.	30.914	0.652	0.424
ABC	2.	19.539	0.412	0.665
BCS-WITHIN	45.	47.430		
D(DECISION TYPE)	1.	6.281	0.086	0.771
AD	2.	43.076	0.587	0.560
DS-WITHIN	45.	73.375		
BD	1.	0.457	0.010	0.921
ABD	2.	19.945	0.432	0.652
BDS-WITHIN	45.	46.160		

(continued)

APPENDIX N.1 (CONTINUED)

ANALYSIS OF VARIANCE OF LEVELS DECISIONS LATENCIES PRECEDING NONWORD TRIALS

SOURCE	DF	MS	F	
CD	1.	336.152	5.528	0.023
ACD	2.	300.053	4.934	0.012
CDS-WITHIN	45.	60.812		
BCD	1.	117.133	2.281	0.138
ABCD	2.	17.916	0.349	0.707
BCDS-WITHIN	45.	51.357		

APPENDIX N.2

ANALYSIS OF VARIANCE OF LEVELS DECISIONS, ERROR RATES PRECEDING NONWORD TRIALS

SOURCE	DF	MS	F	P
A(LEVEL)	2.	96288.000	0.607	0.549
S-WITHIN	45.	158615.438		
B(ORDER)	1.	412640.000	24.303	0.001
AB	2.	6520.000	0.384	0.683
BS-WITHIN	45.	16978.844		
C(NONWORD TYPE)	1.	42368.000	5.590	0.022
AC	2.	11568.000	1.526	0.228
CS-WITHIN	45.	7578.664		
BC	1.	64.000	0.011	0.916
ABC	2.	15664.000	2.746	0.075
BCS-WITHIN	45.	5704.531		
D(DECISION TYPE)	1.	1300608.000	81.142	0.001
AD	2.	1168.000	0.073	0.930
DS-WITHIN	45.	16028.797		
BD	1.	272.000	0.017	0.898
ABD	2.	46736.000	2.871	0.067
BDS-WITHIN	45.	16277.688		

(continued)

APPENDIX N.2 (CONTINUED)

ANALYSIS OF VARIANCE OF LEVELS DECISIONS, ERROR RATES PRECEDING NONWORD TRIALS

SOURCE	DF	MS	F	P
CD	1.	2544.000	0.444	0.509
ACD	2.	6072.000	1.059	0.355
CDS-WITHIN	45.	5732.621		
BCD	1.	896.000	0.076	0.784
ABCD	2.	15208.000	1.285	0.287
BCDS-WITHIN	45.	11838.574		

APPENDIX N.3

ANALYSIS OF VARIANCE OF LEXICAL DECISIONS LATENCIES ON NONWORD TRIALS IN THE LEXICAL ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	55763.199		
A(ORDER)	1.	74064.000	14.818	0.002
AS-WITHIN	15.	4998.398		
B(NONWORD TYPE)	1.	9888.000	2.147	0.164
BS-WITHIN	15.	4605.863		
AB	1.	1008.000	0.208	0.655
ABS-WITHIN	15.	4853.332		
C(DECISION TYPE)	1.	8016.000	1.985	0.179
CS-WITHIN	15.	4037.333		
AC	1.	1152.000	0.181	0.677
ACS-WITHIN	15.	6364.797		
BC	1.	32.000	0.017	0.899
BCS-WITHIN	15.	1921.067		
ABC	1.	640.000	0.199	0.662
ABCS-WITHIN	15.	3219.200		

APPENDIX N.4

ANALYSIS OF VARIANCE OF LEXICAL DECISIONS ERROR RATES ON NONWORD TRIALS IN THE LEXICAL ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	404.662		
A(ORDER)	1.	47.441	1.477	0.243
AS-WITHIN	15.	32.123		
B(NONWORD TYPE)	1.	0.348	0.004	0.953
BS-WITHIN	15.	98.588		
AB	1.	9.746	0.199	0.662
ABS- WITHIN	15.	48.865		
C(DECISION TYPE)	1.	86.797	1.887	0.190
CS-WITHIN	15.	45.995		
AC	1.	107.625	1.501	0.239
ACS-WITHIN	15.	71.697		
BC	1.	52.906	0.922	0.352
BCS-WITHIN	15.	57.386		
ABC	1.	34.574	0.504	0.489
ABCS-WITHIN	15.	68.645		

APPENDIX N.5

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCIES FOR NONWORD TRIALS IN THE PRIME ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	71026.125		
A(ORDER)	1.	120240.000	19.676	0.001
B(NONWORD TYPE)	1.	2432.000	0.630	0.440
AB	1.	1552.000	0.398	0.538
ABS-WITHIN	15.	3897.600		
C(DECISION TYPE)	1.	32.000	0.006	0.938
AC	1.	5616.000	1.001	0.333
ACS-WITHIN	15.	5611.730		
BC	1.	288.000	0.087	0.772
BCS-WITHIN	15.	3302.400		
ABC	1.	6816.000	1.446	0.248
ABCS-WITHIN	15.	4712.531		

APPENDIX N.6

ANALYSIS OF VARIANCE OF LEXICAL DECISION ERROR RATES FOR NONWORD TRIALS IN THE PRIME ALONE CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	15.	344.470		
A(ORDER)	1.	1.250	0.011	0.919
AS-WITHIN	15.	116.423		
B(NONWORD TYPE)	1.	7.973	0.116	0.738
BS-WITHIN	15.	68.591		
AB	1.	14.523	0.210	0.653
ABS-WITHIN	15.	69.121		
C(DECISION TYPE)	1.	319.316	2.681	0.122
CS-WITHIN	15.	119.118		
AC	1.	22.961	0.567	0.463
ACS-WITHIN	15.	40.492		
BC	1.	22.668	0.269	0.612
BCS-WITHIN	15.	84.393		
ABC	1.	218.023	1.942	0.184
ABCS-WITHIN	15.	112.245		

APPENDIX N.7

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCIES FOR NONWORD TRIALS IN THE DOUBLE PRIME CONDITIONS

SOURCE	DF	MS	F	P
S-WITHIN	14.	177982.813		
A (ORDER)	1.	61575.000	12.002	0.004
AS-WITHIN	14.	5130.285		
B(VISUAL SIMILARITY)	1.	1770.000	1.861	0.194
BS-WITHIN	14.	950.857		
AB	1.	7830.000	2.814	0.116
ABS-WITHIN	14.	2782.857		
C (DECISION TYPE)	1.	45.000	0.010	0.923
CS-WITHIN	14.	4689.141		
AC	1.	1335.000	0.567	0.464
ACS-WITHIN	14.	2355.428		
BC	1.	1050.000	0.622	0.443
BCS-WITHIN	14.	1688.000		
ABC	1.	4125.000	2.015	0.178
ABCS-WITHIN	14.	2046.857		

APPENDIX N.8

ANALYSIS OF VARIANCE OF LEXICAL DECISION ERROR RATES FOR NONWORD TRIALS IN THE DOUBLE PRIME CONDITION

SOURCE	DF	MS	F	P
S-WITHIN	14.	893.963		
A (ORDER)	1.	123.999	0.917	0.354
AS-WITHIN	14.	135.205		
B(VISUAL SIMILARITY)	1.	501.910	4.653	0.049
BS-WITHIN	14.	107.877		
AB	1.	36.335	0.360	0.558
ABS-WITHIN	14.	100.926		
C (DECISION TYPE)	1.	19.109	0.227	0.641
CS-WITHIN	14.	84.083		
AC	1.	49.622	0.327	0.576
ACS-WITHIN	14.	151.630		
BC	1.	95.043	1.114	0.309
BCS-WITHIN	14.	85.300		
ABC	1.	22.500	0.189	0.670
ABCS-WITHIN	14.	119.095		

APPENDIX N.9

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCIES ON NONWORD TRIALS IN THE THREE STANDARD LEVELS CONDITIONS

SOURCE	DF	MS	F	P
A(LEVEL)	2.	220528.000	2.343	0.108
S-WITHIN	45.	94103.063		
B(ORDER)	1.	585615.000	46.565	0.001
AB	2.	352.000	0.028	0.972
BS-WITHIN	45.	12576.355		
C(NONWORD TYPE)	1.	8144.000	1.097	0.300
AC	2.	1832.000	0.247	0.782
CS-WITHIN	45.	7423.285		
BC	1.	1120.000	0.147	0.704
ABC	2.	2000.000	0.262	0.771
BCS-WITHIN	45.	7640.176		
D(DECISION TYPE)	1.	170688.000	18.135	0.001
AD	2.	5872.000	0.624	0.540
DS-WITHIN	45.	9411.910		
BD	1.	1680.000	0.203	0.655
ABD	2.	1240.000	0.150	0.861
BDS-WITHIN	45.	8282.242		

APPENDIX N.9 (CONTINUED)

ANALYSIS OF VARIANCE OF LEXICAL DECISION LATENCIES ON NONWORD TRIALS IN THE THREE STANDARD LEVELS CONDITIONS

SOURCE	DF	MS	F	P
CD	1.	27440.000	7.509	0.009
ACD	2.	2088.000	0.571	0.569
CDS-WITHIN	45.	3654.400		
BCD	1.	4160.000	0.803	0.375
ABCD	2.	1936.000	0.374	0.690
BCDS-WITHIN	45.	5180.797		

APPENDIX N.10

ANALYSIS OF VARIANCE OF LEXICAL DECISION ERROR RATES ON NONWORD TRIALS IN THREE THREE STANDARD LEVELS CONDITIONS

SOURCE	DF	MS	F	P
A (LEVEL)	2.	13.613	0.066	0.937
S-WITHIN	45.	207.391		
B (ORDER)	1.	41.766	0.275	0.603
AB	2.	11.088	0.073	0.930
BS-WITHIN	45.	151.980		
C (NONWORD TYPE)	1.	1.422	0.012	0.912
AC	2.	75.631	0.658	0.523
CS-WITHIN	45.	114.916		
BC	1.	70.059	0.846	0.363
ABC	2.	70.453	0.851	0.434
BCS-WITHIN	45.	82.793		
D (DECISION TYPE)	1.	705.336	6.410	0.015
AD	2.	33.574	0.305	0.739
DS-WITHIN	45.	110.044		
BD	1.	1.074	0.013	0.909
BDS-WITHIN	45.	81.142		
CD	1.	67.758	0.591	0.446
ACD	2.	95.291	0.832	0.442
CDS-WITHIN	45.	114.597		

APPENDIX N.10 (CONTINUED)

ANALYSIS OF VARIANCE OF LEXICAL DECISION ERROR RATES ON NONWORD TRIALS IN THE THREE STANDARD LEVELS CONDITIONS

SOURCE	DF	MS	F	P
CD	1.	67.758	0.591	0.446
ACD	2.	95.291	0.832	0.442
CDS-WITHIN	45.	114.597		
BCD	1.	13.504	0.106	0.746
ABCD	2.	48.977	0.384	0.683
BCDS-WITHIN	45.	127.608		

APPENDIX 0.1

ANALYSIS OF VARIANCE OF RECALL

FOR LEVELS ITEMS FOR THREE STANDARDS LEVELS

SOURCE	DF	MS	F	P
A (LEVEL)	2.	140.784	5.263	0.009
S-WITHIN	45.	26.747		
B (RELATIONSHIP)	4.	365.646	35.489	0.001
AB	8.	35.289	3.425	0.001
BS-WITHIN	180.	10.303		

APPENDIX O.2

ANALYSIS OF VARIANCE OF RECALL FOR LEXICAL ITEMS FOR THREE STANDARD LEVELS

SOURCE	DF	MS	F	P
A (LEVEL)	2.	4399.723	70.455	0.001
S-WITHIN	45.	62.448		
B (RELATIONSHIP)	4.	294.908	12.192	0.001
AB	8.	17.485	0.723	0.671
BS-WITHIN	180.	24.189		